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An information processing model was used to examine the organization of stimulus information during the input process among educable mentally retarded (EMR) and normal boys. Three groups of subjects (Ss) were matched on socio-economic status and race--a group of EMR boys, a group of normal boys matched with the EMR Ss on chronological age (CA normal group), and a group of normal boys matched with the EMR Ss on mental age (MA normal group). Each group was subdivided into two age groups. The older subgroups received three grouping tasks--objects, pictures, and words. The younger subgroups received two grouping tasks--objects and pictures. The responses of the Ss were coded into grouping strategy categories--superordinate, complexive, or thematic. As hypothesized, the results revealed that EMR Ss used fewer superordinate strategies than either equal CA normal Ss or equal MA normal Ss. No differences were found in the effects of age on performance of EMR and equal CA normal Ss. Neither were differential effects of stimulus materials evidenced in the results. Differences found in the performance of normal and EMR Ss were related to findings of other studies of cognitive abilities among EMR Ss. Partial support was found for the hypothesis that increasing numbers of stimuli decrease the use of efficient grouping strategies among EMR subjects. (AMM)

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ASSOCIATIVE GROUPING STRATEGIES AMONG EDUCABLE MENTALLY RETARDED AND NORMAL BOYS[1]

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An information processing model was used to examine cognitive functioning of mentally retarded children. Studies of cognitive performance have suggested that retarded children are inadequate in the organization of stimulus information during the input process. Hence, an examination of input organization in normal and retarded children was undertaken. Bruner and Olver's (1965) model of associative grouping strategies was selected as a means to objectify the organizational process. Bruner and his colleagues found that the responses of normal children on a grouping task reflect three basic strategies: superordinate, complexive, and thematic. The superordinate strategy is the most efficient of the 3 in terms of information reduction. As intelligence develops, strategies of grouping have been found to become more efficient.

The investigator hypothesized that educable mentally retarded (EMR) subjects use fewer efficient (superordinate) strategies on grouping tasks than do normal subjects of the same chronological age (CA), or normal subjects of the same mental age (MA). A cumulative deficit was hypothesized in the performance of EMR subjects as compared to equal CA normal subjects. The performance of EMR subjects was hypothesized to be adversely affected by increasing numbers of stimulus items in the grouping tasks. The stimulus materials were also expected to affect the performance of EMR subjects, with most efficient strategies being used on the object grouping task, and fewest on the word grouping task.

A research design required the selection of 3 groups of subjects: a group of EMR boys, a group of normal boys matched with the EMR subjects on CA (CA normal group), and a group of normal boys matched with the EMR subjects on MA (MA normal group). Each group was subdivided into 2 age groups. The older 3 subgroups received 3 grouping tasks: objects, pictures, and words. The younger 3 subgroups received 2 grouping tasks: objects and pictures. Groups were matched on socio-economic status and race. The order of administration of the 3 tasks was counter-balanced with 3 stimulus lists so that effects due to order and list would not affect the dependent variable. The responses of the subjects were coded into grouping strategy categories by 2 judges.

As hypothesized, the results revealed that EMR subjects used fewer superordinate strategies than either equal CA normal subjects or equal MA normal subjects. Contrary to the cumulative deficit hypothesis, no differences were found in the effects of age on the performance of EMR and equal CA normal subjects. Partial support was found for the hypothesis that increasing numbers of stimuli decrease the use of efficient grouping strategies among EMR subjects. Finally, differential effects of stimulus materials were not evidenced in the results.

Differences found in the performance of normal and EMR subjects were related to findings of other studies of cognitive abilities in EMR subjects.

Results relative to the cumulative deficit hypothesis were viewed as inconclusive since a ceiling effect was apparently operative among the older equal CA normal group. Effects of the number of stimuli in the group were found to be influenced by the difficulty of the task for the younger EMR subjects.

The grouping strategies model was related to various theories pertaining to cognitive performance and development. Implications of the findings for language and for education were discussed.

The grouping strategies model served as a useful tool for studying input organization in EMR children. The finding that EMR subjects use fewer efficient grouping strategies than equal CA or equal MA normal children provides insight into their poor performance on cognitive tasks. It seems reasonable to propose a training program for EMR subjects in the use of efficient grouping strategies. If successful, such a program could have far reaching effects on the cognitive performance of EMR children.

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I. Statement of the Problem

Mentally retarded (MR) children are characterized by their slowness and inefficiency in acquiring knowledge and skills (Robinson & Robinson, 1965). Theorists have attributed this deficiency to various factors, such as impoverished stimulus trace (Ellis, 1963), cortical satiation (Spitz, 1963), inability to attend to relevant stimuli (Zeaman & House, 1963), inadequate arousal (Semmel, 1965), and lack of social reinforcement (Zigler, 1963). Recently Spitz (1966) has focused on the role of input organization in the learning of MRs. He suggested that their learning deficiencies may result from an inability to organize their stimulus environment. Thus, MR children may be overloaded by incoming information.

The method by which the human organism processes information has been a concern of many psychological theorists (Broadbent, 1958; Bruner, Goodnow & Austin, 1956; Miller, 1956). The learner must commonly function in an environment in which he is bombarded with varied stimuli. Every discriminable aspect of these stimuli is an item of information (Guilford & Hoepfner, 1963). The learner can be defined as an agent for dealing with information (Guilford, 1959). He must organize the stimulus environment to make it meaningful. This task is referred to in the present work as information processing.

It is generally agreed that the human organism has a limited capacity for information processing (Broadbent, 1958; Bruner et al., 1956; Miller, 1956). Stimulus reduction is therefore a necessity if information is to be successfully processed.

The method by which man reduces the myriad signals impinging on his sensory organs into meaningful information remains a question of considerable theoretical interest. In a discussion of perception, Broadbent (1958) posited a system of 'selective filters' which operate to separate relevant information from irrelevant stimuli. With reference to memory, Miller (1956) suggested that 'bits' of information are recoded into larger 'chunks' before storage. Bruner, Goodnow, and Austin (1956) emphasize the importance of categorization to the ability to process information. They define categorization as the grouping of discriminably different things as equivalent and responding to them in terms of their class membership rather than their uniqueness--a process Gagné (1965) refers to as concept learning. Bruner and his colleagues suggest that all cognitive activity involves and is dependent on the process of categorizing. It is through categorization that the human intellect can reduce the diversity of stimuli in its environment to a cognitive load within its capabilities.

If MRs are deficient in their ability to organize incoming stimuli (Spitz, 1966) then they are facing a constant overload of incoming information. Since the learner has a limited capacity for handling incoming information, either (a) some information in the environment will not be processed or (b) the form in which the information is processed may not be easily accessible in storage. MRs evidence fewer concepts than normal Ss (Rossi, 1963; Stedman, 1963; Stephens, 1964). It seems reasonable to hypothesize that the reason MRs have fewer concepts is that they do not process as much information from their environment as normals. Also, MRs respond with different concepts than normal Ss (Osborn, 1960; Wallace & Underwood, 1964), which may mean that information is stored in a different form.

Evidence seems to indicate that, as Spitz (1966) suggested, input organization may be a major area of deficiency among MRs. Therefore, an examination of the process of input organization in retarded and normal Ss appears to be a fruitful line of research.

A study of input organization requires some means of objectifying the process by which a stimulus array is reduced. According to Bruner and his colleagues (Bruner, Goodnow, & Austin, 1956; Bruner & Olver, 1965; Olver & Hornsby, 1966), the process of categorization can be objectified through the delineation of strategies of associative grouping. In a developmental study, Bruner and Olver (1965) found that the responses of normal children on an associative grouping task reflected three basic strategies: superordinate, complexive, and thematic. These strategies are discussed briefly below and more completely in Appendix D.

Superordinate strategies result in the greatest amount of information reduction and are therefore the most efficient. A response resulting from superordination subsumes all items of a stimulus array under a single attribute or set of attributes common to all members of the array. The information contained in the array is thus reduced from *n* 'bits' to one 'chunk'.

Complexive strategies subsume the items in a stimulus array under an attribute or set of attributes common to part, but not all, members of the array. The resulting groupings are not much less than the sum of their parts. Thus the information reduction value, or efficiency, of complex formations is considerably less than that of superordinate formations. Five complexive strategies have been distinguished: multiple grouping, association, key ringing, edge matching, and collection. (See Appendix D.)

Thematic strategies incorporate all members of the stimulus array into a narrative. Rather than reducing the amount of information in the array, it is increased. Therefore, thematic strategies represent the least economical of the three types.

Bruner and Olver (1965) found that among normal children, the use of superordinate strategies increased with age, while the use of complexive strategies declined. The researchers postulated a developmental theorem based on their findings:

> The development of intelligence...moves in the direction of reducing the strain of information processing by the growth of strategies of grouping that encode information in a manner (a) that chunks information in _simpler_ form, (b) that gains _connectedness_ with rules of grouping already formed, and (c) that is designed to _maximize the possibility of combinatorial operations_ such that groupings already formed can be combined and detached from other forms of grouping. (425-426)

The model of associative grouping strategies developed by Bruner and his associates has been selected in the present study as a technique for examining the process of input organization in educable mentally retarded (EMR) and normal children. Following Bruner's theoretical formulations, it is feasible to posit that the retarded child acquires the more efficient higher order strategies more slowly than the normal child and that his lack of adequate grouping strategies results in inefficient stimulus reduction. Thus the retarded child is under a constant cognitive strain due to his inability to efficiently reduce the information contained in his stimulus environment.

Bruner and Olver's model of strategies of associative grouping was selected to focus on the process of input organization in EMRs. The present study was concerned with comparing the strategies used by EMRs on grouping tasks to those used by normal _S_s matched on chronological age (CA) and normal _S_s matched on mental age (MA). Children from two age ranges were included in order to focus on developmental changes in performance. Task variables to be investigated included the number of stimuli to be grouped, and the nature of the stimulus materials (objects, pictures, or words).

II. Review of the Literature

The present work focuses on an information theory approach to the cognitive deficiencies of mentally retarded children. The previous chapter established a rationale for the writer's approach, and presented the model which guided the empirical aspects of this work.

The literature reviewed in this chapter covers three major areas: (a) literature relating to input organization in the retarded; (b) literature relating to the comparative effects of age on learning in normals and MRs; and (c) literature relating to the effects of stimulus materials on MRs.

Input Organization in the Mentally Retarded

Several methods which have been utilized in studying learning in MRs have given insight into the process of input organization. Spitz (1966) has discussed these in some detail. The studies presented below are representative of the different techniques used and the major findings relating to input organization. The techniques included are: paired-associates, free recall, word associations, Underwood and Richardson's technique, and categorization.

Paired-associate studies. In this technique a list of pairs of stimuli is presented to the S for his examination. Then half of each pair is presented and the S is required to supply the other half. The paired-associate technique is used to study quantity of learning and retention but can also yield information on the input process.

A task requiring the rote learning of word pairs was administered to retarded Ss and normal Ss matched on CA or MA by Ring and Palermo (1961). No differences were found between the performance of retarded

Ss and normal Ss matched on MA. However, retarded Ss were inferior in performance to the normal group matched on CA.

Cantor and Ryan (1962) corroborated the findings of Ring and Palermo (1961) with mentally retarded Ss matched with normal Ss on MA. They further studied the retention of those groups after one week and one month, finding no significant differences between groups and no differences between retention after one week and one month.

Neither Ring and Palermo (1961) nor Cantor and Ryan (1962) attempted to look at the process underlying the performance of their Ss on the memory tasks. However, a recent study by Martin, Boersma, and Bulgarella (in press) used visual presentation of a paired-associate task to study the strategies used by normal and retarded children to learn the pairs. The strategies, based on earlier studies with normal Ss (Martin, Boersma, & Cox, 1965; Martin, Cox, & Bulgarella, 1966), were as follows:

1. No association
2. Repetition
3. Single letter cues
4. Multiple letter cues
5. Word formations
6. Superordinate (selection of elements from each having some relation to each other)
7. Syntactical (selection of elements from the pair and embedding them in a meaningful sentence, phrase, or clause)

They found that educable mentally retarded Ss used fewer high level strategies (6 and 7) than normals matched on CA, but about the same number of intermediate strategies (3-5).

Hohn (1967) extended the work of Martin et al. (in press), in a study of the effects of facilitation, in the form of strategy aids, on the learning and retention of EMRs and normals. He found that if high associative strategy aids were provided for EMRs, their performance was comparable to the unaided normals on both the learning and retention. However, the unaided EMRs were inferior in performance to the aided EMRs on both acquisition and retention.

In summary, paired associate studies have found that EMRs are comparable to normal _S_s matched on MA in both learning and retention (Cantor & Ryan, 1962; Ring & Palermo, 1961) but inferior to normal _S_s matched on CA in both areas (Martin et al., in press; Ring & Palermo, 1961). EMRs used fewer high level strategies to learn than normals matched on CA (Martin et al., in press). If high level strategy aids are provided, their performance is comparable to normals (Hohn, 1967).

Free recall. Studies of the form taken by responses in free recall situations have also contributed to our knowledge of input organization.

A study by Semmel and Herzog (1966) investigated the effects of different form classes (part of speech) on the free recall of EMRs. It was found that EMR _S_s recalled more nouns than verbs, adjectives, or adverbs. This finding indicated that noun stimuli are easier for retarded _S_s to process than other parts of speech.

The development of a technique to measure associative clustering in free recall tasks (Bousfield, 1953) has stimulated a great deal of research. This technique was designed to study the problem of organization in verbal behavior. The verbal organization that takes place in associative clustering is taken as a measure of verbal mediation or concept utilization. Bousfield (1953) implied that clustering is evidence for a central organizing tendency operating in the human intellect.

Weatherwax and Benoit (1957) used the associative clustering technique to study the effect of brain injury on the mentally retarded individual's capacity for abstract thinking. A picture grouping task was administered to equal MA groups of organic and non-organic retarded children. No differences were found on clustering performance or number of words recalled. However, the method used for matching Ss on MA, which was based on the Stanford-Binet, might have caused a selective factor to operate in the choice of a sample.

Equal MA groups of familial and organic retardates and normal Ss were presented a picture grouping task by Osborn (1960). No significant differences were found between the groups on clustering or total words recalled. However, it was found that the retarded groups demonstrated 'qualitative inefficiencies' in the overall pattern of their learning which Osborn related to inappropriate learning habits.

In contrast to Osborn (1960), Rossi (1963) found that equal MA groups of normal and retarded Ss differed significantly in associative clustering performance, but not on total words recalled. An explanation for these contradictory results has been offered by Rossi. He suggested that differences in the stimulus materials might have produced a difference in results. Rossi's stimuli were verbal, while Osborn used both pictures and verbal stimuli. The pictures used in Osborn's study might have given the retarded Ss additional cues so their clustering performance compared with that of normal Ss.

Stedman (1963) used verbal stimuli in a recall task in which he studied associative clustering. Unlike Rossi (1963), his Ss were normal and retarded children matched on CA. He found the normal Ss were superior to the retarded Ss both on number of word pairs recalled and number of word pairs clustered. Stedman's results indicated a qualitatively different recall process in retardates. Their clusters were not the same as those used by normal Ss.

Evans (1964) used Rossi's (1963) word list and studied recall and associative clustering among high and low IQ adult retarded groups. He found differences only on trials to criterion. This study is difficult to relate to the others since adult Ss were used and neither MA nor CA was controlled.

Wallace and Underwood (1964) studied the occurrence of implicit associative responses (IARs) to verbal stimuli in retarded and normal Ss in relation to clustering scores. An IAR is a response elicited by the stimulus properties of a representational response. Their data confirmed the hypothesis that IARs occur with less frequency among MRs; and equal CA normals had higher clustering scores.

In summary, studies of associative clustering in free recall tasks with mentally retarded Ss have generally revealed (a) no differences between organic and familial retardates (Osborn, 1960; Weatherwax & Benoit, 1957), (b) that equal MA normals clustered more than retardates on verbal tasks (Rossi, 1963) but not on picture tasks (Osborn, 1960), (c) that equal CA normals clustered more than retardates (Stedman, 1963; Wallace & Underwood, 1964), and (d) no differences in total words recalled between retarded Ss and equal MA normals (Osborn, 1960; Rossi, 1963; Weatherwax & Benoit, 1957).

Word association tasks. The types of associations given to word stimuli can also give an indication of input organization. A word association task was administered to EMR, equal CA normal and equal MA normal Ss (Semmel, Barritt, Bennett, & Perfetti, 1966). It was found that equal CA normal Ss gave more paradigmatic (same form class) associations than EMRs. Apparently older normal children organize by classes of things, such as nouns while older retarded children often organize by contiguity of ideas, such as adjective-noun.

Underwood and Richardson's technique (1956) found a relationship between word associations and scores on a categorization task. They investigated the ability of retarded Ss to use verbal mediators as organizers of information. They presented groups of four nouns to a S and asked him to state an attribute possessed by all the objects represented by the nouns. The same nouns had previously been presented in a controlled association task to another group of Ss. It was found that the speed at which a S attained a concept was directly related to the frequency with which the attribute sought was given as a response to those nouns in the association task.

The Underwood and Richardson technique was used by Griffith and Spitz (1958) in a study of mildly retarded adolescent boys. Half of the boys received the association task first, and the other half received the abstraction task first. It was found that the retarded Ss were more likely to achieve a verbal abstraction when they had defined at least two of the three nouns used in the abstraction task in terms of a common descriptive word. The authors suggested that the common descriptive term mediated the abstraction. Two other studies corroborated this finding (Griffith, 1960; Griffith, Spitz, & Lipman, 1959).

Miller and Griffith (1961) attempted to train retarded Ss in the use of verbal associations. Relevant attributes were reinforced with one group, irrelevant attributes with another, and the third group received no treatment. It was found that the differential reinforcement had no differential effect on the performance of the trained groups. However, the trained groups performed better than the controls on the nouns used in training. The learning did not transfer to nouns not used in training. The findings in the Miller and Griffith (1961) study disagreed with those of Bensberg (1958), who, in an earlier study, found that Ss trained on the relevant dimension of similarity (form or color) performed better on an abstraction task than those trained on the irrelevant dimension. However, the procedures and stimulus materials in the two studies were different and the disparity in findings might have been due to these factors.

In summary, this series of studies suggested that retarded Ss differed from normal Ss in their ability to use verbal mediators in an abstraction task (Griffith, 1960; Griffith & Spitz, 1958; Griffith, Spitz, & Lipman, 1959). When mediators were provided in the training task, the performance of retarded Ss improved (Bensberg, 1958; Miller & Griffith, 1961).

Categorization studies. The number and nature of the categories used in grouping lists of stimuli also give insight into the nature of the input organization of retarded Ss.

Stephens (1964) hypothesized that the reason EMRs are not able to utilize categorization adequately as an intellective tool was that EMRs possess relatively fewer conceptual categories. He used a categorization task in which EMRs and CA matched normals were required to identify items presented on a set of cards representing 25 categories. He found that the EMRs were able to identify fewer of the categories than the normals.

Van Osdol (1964) used Stephen's (1964) categorization cards to study the relationship of response delay and total task time on both visual and auditory structured categorization tasks. He found that EMRs required more total time to complete a task and that visual stimuli were of more value to them than to normal children in forming concepts. Neither response delay nor total task time had any significant correlation with correct responses of either normals or EMRs. This finding is in contrast to that of Stephens (1964).

In a study using an object sorting task, Safford (1967) found retarded Ss to be inferior in performance to equal CA normals. EMRs had fewer concepts, as measured by fewer correct sorts, as well as different concepts. Safford concluded that EMRs differ from normals in both quantitative and qualitative aspects of concept learning.

In summary, the studies of categorization among retarded Ss have shown that EMRs give fewer of the associative responses given by normals matched on CA on an association task (Stephens, 1964); that EMRs evidence fewer concepts than equal MA normal Ss (Safford, 1967); that EMRs use different concepts than equal MA normals (Safford, 1967); that EMRs require more time to complete a task; and that visual stimuli are of more value to them in forming concepts (Van Osdol, 1964). However, Stephens (1964) and Van Osdol (1964) disagree on the performance of EMRs and equal CA normals in terms of number of correct responses. They used the same tasks with similar populations. The only readily apparent explanation for this discrepancy seems to lie in the time factor introduced by Van Osdol.

Effects of Chronological Age

One of the variables which affect ability to process information is age. As the normal child matures, he uses more efficient means of information processing. In a developmental study with normal children, Hagen (1967) found that older children recalled more relevant information on a memory task than young children. Hagen and Sabo (1967) presented third, fifth, seventh, and ninth grade normal children with a memory task in which instructional set was manipulated. The results were interpreted as supporting the hypothesis that more efficient information processing develops with increasing age. Bruner and Olver (1965) found that older normal children used more superordinate strategies and fewer complex formations than young normal children.

A number of educators in the field of retardation have posited that age does not effect MRs in the same way it effects normal *S*s (Dunn, 1963; Kirk & Johnson, 1951). They contend that MRs fall farther and farther behind equal CA normals in learning. The increase in differential learning with age has been called the Cumulative Deficit Hypothesis.

Dunn (1963) has discussed the concept of cumulative deficit among EMR children. He presented a table (see Table 1) which demonstrates that the range of individual differences in mental age increases with chronological age. Retarded children keep falling farther and farther behind their normal CA mates as they move into junior and senior high school.

TABLE 1

Estimated Mental Ages for Increasing Chronological Ages and Intelligence Quotient Scores

	Chronological Ages										
IQ	6	7	8	9	10	11	12	13	14	15	16 & on
30	1-10	2-1	2-5	2-8	3-0	3-3	3-7	3-11	4-2	4-5	4-10
40	2-5	2-10	3-2	2-7	4-0	4-5	4-10	5-2	5-7	6-0	6-5
50	3-0	3-6	4-0	4-6	5-0	5-6	6-0	6-6	7-0	7-6	8-0
55	3-4	3-10	4-5	4-11	5-6	6-1	6-6	7-2	7-8	8-3	8-9
60	3-7	4-2	4-10	5-4	6-0	6-7	7-2	7-9	8-4	8-11	9-7
65	3-11	4-7	5-2	5-10	6-6	7-2	7-9	8-5	9-1	9-8	10-4
70	4-3	4-11	5-7	6-4	7-0	7-8	8-5	9-1	9-9	10-5	11-2
75	4-6	5-3	6-0	6-9	7-6	8-3	9-0	9-9	10-6	11-3	12-0
85	5-1	5-11	6-10	7-8	8-6	9-4	10-2	11-0	11-11	12-9	13-7

(Dunn, 1963, p. 62)

As can be seen in Dunn's table, a retarded child, whose IQ is 65, is 2 years and 1 month of mental age behind an equal CA normal child (IQ 100) at the age of 6. However, when that retarded child reaches 14, he is 4 years and 11 months behind the equal CA normal child in mental age.

Deutsch (1965) has studied this problem in relation to disadvantaged children. He found, in comparing lower class and middle class children at the first grade level and the fifth grade level, that differences are greater at the fifth grade level and that they appear in a greater variety of areas. He interpreted these results as an accumulation of small deficiencies in learning at an early age which led to inferior learning and thus increased the magnitude of the deficiency.

John (1963) studied the linguistic and cognitive behavior of three socioeconomic groups of Negro first and fifth graders. Differences at the first grade level were not significant, however the higher status children performed significantly better on the fifth grade level on categorization tasks.

The dynamics leading to a cumulative deficit in the achievement of EMRs were discussed by Kirk and Johnson (1951). They indicated that an EMR child who is reaching the fourth grade level chronologically is just beginning to acquire the tool of reading. This tool has been used by his CA mates for two or more years and has functioned as a major factor in their expansion of knowledge and skills.

In summary, empirical studies in the area of the comparative effect of age on learning of retarded and normal children are practically non-existent. The educators in the field who have touched upon the problem present it as self evident (Dunn, 1963; Kirk & Johnson, 1951). The only empirical studies which have found evidence for a cumulative deficit are in the area of the culturally disadvantaged child (Deutsch, 1965; John, 1963).

Effects of Stimulus Materials

Another factor which influences performance on an information processing task is the form in which the information is presented; that is, the type of stimulus materials. In order to ascertain how mentally retarded children may respond to different types of stimulus materials, two areas of literature are presented: first, literature relating to the concreteness of MRs; then literature directly concerned with the effects of differential stimuli.

Concreteness of MRs. Retarded persons have traditionally been considered more concrete in their approach to concept learning than normal persons (Denny, 1964: Iscoe & Giller, 1959). Goldstein and Scheerer's work with brain-injured adults (1941) gave impetus to studies of individual differences in abstract performance. These authors differentiated between abstract and concrete behavior. They found that normal adults could assume both types of behavior while brain-injured adults were confined to the concrete mode. This finding was extended to brain-injured children by the work of Strauss and Werner (Strauss & Werner, 1942; Werner & Strauss, 1943).

Most studies relating to abstract behavior in MRs have compared the performance of familial Ss and brain-injured Ss. These studies were considered to have little value for the present work and therefore are not reviewed here. The interested reader is referred to a review by Rosenberg (1963). However, those studies of abstract behavior which included a normal comparison group, as well as a retarded group, are reported as pertinent to this investigation.

Studies of abstract behavior have generally used performance on sorting tasks as a dependent variable. Rosenberg (1963) reported the results of two early studies (Bolles, 1937; Kounin, 1941) which found that normals performed on a more abstract level than retarded Ss. A study by Prothro (1943) found that normal Ss shifted their basis for grouping more easily than retarded Ss. Korstvedt, Stacey, and Reynolds (1954) found that normals were more often able to utilize more than one sorting principle and were able to identify the basis for their sort more often than MRs. Halpin (1958) also found MRs utilized only one basis for sorting.

The above studies support the assumption that MRs exhibit more concrete behavior on sorting tasks than do normals. Educational techniques for the mentally retarded have attempted to compensate for their deficiencies in abstraction (Strauss & Lehtinen, 1947). Thus classes for the retarded abound with concrete learning aids which can be manipulated by the children. Many visual aids are also used. These educational procedures have not been carefully tested in any study to date. However, several studies have reported the effects of different stimulus materials.

Stimulus materials. Van Osdol (1964) found that visual stimuli improved the performance of EMRs over verbal stimuli. Osborn (1960) found no differences between EMRs and normals matched on MA on clustering tasks when visual and verbal stimulus materials were used, but Rossi (1963) found a difference when only word tasks were used. This disparity seems to point to the different stimulus materials.

Renz (1963) investigated the effects of differential stimuli in concept formation among the educable mentally handicapped. He taught one group of EMRs sensory concepts using pictures; and a second group was taught using objects. He found no differences between these two types of stimulus materials.

Finley (1962) found that neither EMRs nor normals did as well on a concrete arithmetic achievement measure as on the pictorial or symbolic measures. This study, however, was confounded by lack of controls on the intergroup differences.

In a study comparing the performance of bright (IQ 119-143) and EMR (IQ 53-80) children on a learning task using abstract and semi-concrete stimulus materials, Wallis (1963) found that the EMR group did significantly better on the semi-concrete items than on the abstract items. The bright group also did slightly better on the semi-concrete items but the difference was not significant.

Three tasks representing three levels of abstraction were used by Carr (1964) in a study of EMRs and equal MA normals. The Goldstein-Scheerer Object Sorting Test was considered the most concrete task; the Weigl Card Sorting Test represented an intermediate level of abstraction; and the Similarities subtest from the Wechsler Intelligence Scale for Children represented the most abstract task. Carr found no significant differences between the performances of EMRs and equal MA normals on these tasks. He concluded that his findings did not support the idea that EMRs are more concrete than normals.

In summary, most studies have supported the contention that MRs are more concrete in their behavior than normals (Halpin, 1958; Korstvedt et al., 1954; Prothro, 1943; Rosenberg, 1963). In contrast, Carr's (1964) study found no differences in abstract performance between EMRs and equal MA normals. Findings relating to the effects of different stimulus materials have been somewhat contradictory. More concrete stimuli appeared to have a positive effect on the performance of MRs in Van Osdol's (1964) study and Wallis's (1963) study, but a negative effect in Finley's (1962) research. Renz (1963) and Carr (1964) found no differences due to stimulus materials.

Summary

The preceding review has covered three major aspects of the literature: (a) studies relating to input organization in MRs; (b) studies relating to the effects of CA on learning of MRs and equal CA normals; and (c) studies relating to the effects of different stimulus materials on MRs.

The studies reviewed which related to input organization have generally found that the performance of EMRs is inferior to that of equal CA normals. Qualitative as well as quantitative differences have been found. Qualitative differences have also been found between the performance of EMRs and equal MA normals. These findings led the investigator to include both equal CA normal Ss and equal MA normal Ss in the present study.

Although performance changes with age have been well documented with normal children (Hagan, 1967; Hagan & Sabo, 1967), virtually no research has compared age changes in normal children and retarded children. Yet the cumulative deficit hypothesis is widely accepted among educators in the field of mental retardation. Therefore the present study proposed to look at the differential effects of age on EMR and normal Ss.

Studies of the effects of stimulus materials on EMRs have yielded equivocal results. Van Osdol (1964) and Wallis (1963) obtained positive results with EMRs by using more concrete stimuli, while Finley's (1962) results were negative. Renz (1963) and Carr (1964) found no differences.

The lack of conclusive evidence on the effect of different stimulus materials led the investigator to include stimulus materials as a variable in the present study.

Chapter III presents the hypotheses which were generated from two sources; the model of grouping strategies and the review of the literature.

III. Hypotheses

The present research focused on Spitz's (1966) contention that MRs have a deficiency in input organization. In order to study the process of input, Bruner and Olver's (1965) model of associative grouping strategies was selected. The hypotheses below are framed in terms of the grouping strategies model and are derived from the research findings relating to input organization in the retarded which are reviewed in the previous chapter.

Specifically, the present study sought to (a) compare the grouping strategies used by educable mentally retarded (EMR) _Ss_ to those used by normals, (b) examine differential effects of age on grouping strategies in retarded and normal _Ss_, (c) examine the effects of differential numbers of stimuli on the grouping strategies used by EMRs, and (d) examine the effects of different types of stimulus materials on the grouping strategies of EMRs.

Relative Performance of Retarded and Normal Children (Groups)

The first two hypotheses relate to comparisons between EMR and normal groups.

Hypothesis 1: EMR boys use fewer superordinate strategies on associative grouping tasks than equal CA normal boys of the same socioeconomic status.

1.A. Adolescent EMR boys use fewer superordinate strategies on three associative grouping tasks (object, picture and word grouping) than equal CA normal boys.

1.B. Young EMR boys use fewer superordinate strategies on two associative grouping tasks (object and picture grouping) than equal CA normal boys.

1.C. Combined groups of adolescent and young EMR boys use fewer superordinate strategies on two associative grouping tasks (object and picture grouping) than equal CA normal boys.

The comparison of EMR and equal CA normal Ss was undertaken in order to investigate differences in grouping strategies between two groups of the same physiological development, as measured by CA, but differing levels of mental development. The prediction of differences was based on the literature reflecting the paucity of categories among EMRs (Stephens, 1964) and the position that their deficit resulted from deficient input organization. It was expected that the EMRs deficit would be reflected in the usage of fewer high order grouping strategies than equal CA normals. According to the grouping strategies model, more efficient strategies are acquired as intelligence develops. Thus the EMRs would be expected to use fewer efficient strategies than the more intelligent equal CA normals.

A test of Hypothesis 1.A required the administration of object, picture, and word grouping tasks to a group of adolescent EMR boys and a group of equal CA normal boys of comparable socioeconomic status. 1.B required the administration of object and picture grouping tasks to a group of young EMR boys, and a group of equal CA normal boys of comparable socioeconomic status. 1.C required a combination of the data gathered on the object and picture grouping tasks for the adolescent and young EMR groups and for both equal CA groups.

Hypothesis 2. EMR boys use fewer superordinate strategies on associative grouping tasks than equal MA normal boys of the same socioeconomic status.

2.A. Adolescent EMR boys use fewer superordinate strategies on three associative grouping tasks (object, picture, and word grouping) than equal MA normal boys.

2.B. Young EMR boys use fewer superordinate strategies on two associative grouping tasks (object and picture grouping) than equal MA normal boys.

2.C. Combined groups of adolescent and young EMR boys use fewer superordinate strategies on two associative grouping tasks (object and picture grouping) than equal MA normal boys.

The comparison of EMR and equal MA normal Ss was undertaken in order to investigate differences in grouping strategies between two groups of the same mental age. The position taken is that the similar point in mental development of these two groups reflected by intelligence tests fails to reveal an underlying difference in process. Evidence for a difference in the input organization of EMRs and equal MA normals was found in a study by Rossi (1963) in which he found EMRs clustered less than normals on a recall task. It is expected that this difference in process can be measured in terms of the usage of fewer high order strategies on associative grouping tasks by the EMR group.

A test of Hypothesis 2.A required the administration of object, picture, and word grouping tasks to a group of adolescent EMR boys and a group of equal MA normal boys of comparable socioeconomic status. 2.B required object and picture grouping tasks to be administered to a group of young EMR boys and a group of equal MA normal boys. 2.C required the combination of data from the object and picture grouping tasks for the adolescent and young EMR groups and for both equal MA groups.

Age Effects

Bruner and Olver's (1965) work with normal Ss revealed a growth of more efficient strategies of grouping as a function of increased chronological age. It was expected that EMRs would also use more efficient strategies as a function of CA. However, a cumulative deficit was hypothesized. That is, the equal CA normal group would grow in use of efficient strategies more rapidly than the EMRs and thus the EMRs would exhibit a deficit which would become more marked as they grow older. This hypothesis may be stated as follows:

Hypothesis 3: There is a greater difference between the number of superordinate strategies used on associative grouping tasks by older EMR boys and equal CA normal boys than by young EMR boys and equal CA normal boys holding socioeconomic status constant.

As indicated above, this hypothesis is derived from evidence cited in Chapter II that as the EMR grows older he falls farther and farther behind his CA age mates.

A test of Hypothesis 3 required the administration of associative grouping tasks to an adolescent group and a young group of EMRs and two comparable age groups of equal CA normals equated on socioeconomic status. A significant interaction between age and group is expected.

Effects of the Number of Stimuli

Another factor which influences the performance of Ss on a grouping task is that of the number of stimuli to be grouped.

Hypothesis 4: EMR boys use more superordinate strategies in grouping small numbers of stimuli on an associative grouping task than in grouping larger numbers of stimuli.

The above prediction derives from evidence that normal children use fewer superordinate grouping strategies as the number of stimuli in the group increases (Bruner & Olver, 1965). It is expected that EMR Ss perform in a similar fashion.

A test of this hypothesis required the administration of an associative grouping task to a group of EMR boys and a comparison of the number of superordinate strategies used on a small group of stimuli to the number used on a large group of stimuli.

Effects of Stimulus Materials

The nature of stimulus materials presented in a grouping task is assumed to be a factor influencing grouping strategies.

Hypothesis 5: The nature of the stimuli presented (objects, pictures, or words) on associative grouping tasks has a differential effect on the number of superordinate strategies used by EMR boys.

5.A. The number of superordinate strategies used by adolescent EMR boys on associative grouping tasks varies with the nature of stimuli used.

(1) Adolescent EMR boys use more superordinate strategies on an associative grouping task using object stimuli than on a task using picture stimuli.

(2) Adolescent EMR boys use more superordinate strategies on an associative grouping task using object stimuli than on a task using word stimuli.

(3) Adolescent EMR boys use more superordinate strategies on an associative grouping task using picture stimuli than on a task using word stimuli.

5.B. Young EMR boys use more superordinate strategies on an associative grouping task using object stimuli than on a task using picture stimuli.

5.C. Combined groups of equal numbers of adolescent and young EMR boys use more superordinate strategies on an associative grouping task using object stimuli than on a task using picture stimuli.

These predictions derived from the research reviewed demonstrating the greater concreteness of retardates from which it is inferred that a hierarchy of concreteness of task (object, picture, word) represents a hierarchy of difficulty to retarded Ss. Also Bruner and Olver's work (1965) found evidence that normal children revert to lower order strategies as the grouping task becomes more difficult.

A test of Hypothesis 5.A required the administration of associative grouping tasks using object stimuli, picture stimuli, and word stimuli to a sample of adolescent EMR boys. 5.B required the administration of associative grouping tasks using object stimuli and picture stimuli to a sample of young EMR boys. 5.C required the combination of data from the object and picture grouping tasks across the adolescent and young EMR samples.

In summary, the hypotheses presented above were designed to compare the strategies used by EMRs and normals on associative grouping tasks. It was predicted that EMRs use fewer superordinate strategies than either equal CA normals or equal MA normals. A cumulative deficit in the performance of EMRs was hypothesized in relation to the performance of equal CA normals. The performance of EMRs was hypothesized to be adversely affected by increasing numbers of stimuli in the grouping tasks, and by stimulus materials which were more abstract. Chapter IV presents the research design and the procedures by which the hypotheses were tested.

IV. Method

The following discussion describes the selection of Ss and the procedures which implemented the testing of the five hypotheses presented in Chapter III. The research design required the selection of three groups of Ss: a group of educable mentally retarded (EMR) boys, a group of normal boys matched with the EMRs on chronological age (CA) and a group of normal boys matched with the EMRs on mental age (MA). Each group was subdivided into two age groups. The older three subgroups received three grouping tasks: objects, pictures, and words. The younger three subgroups received two grouping tasks: objects and pictures.

Subjects

Four elementary schools and one junior high in Jackson, Michigan, were used in this study. Two of the elementary schools were in middle class neighborhoods and two were in lower class areas. The junior high covered areas of both types. A total of 108 Ss were selected including 36 educable mentally retarded Ss from special classes (EMR group), 36 Ss from regular classes matched with the EMRs on chronological age (CA normal group) and 36 Ss from regular classes matched with the EMRs on mental age (MA normal group).

EMR group. A total of five elementary special classes for the EMR and two junior high special classes were involved. A stratified random sample of EMR Ss was selected from those seven classes. EMR boys having secondary disabilities which might influence their performance were excluded from the sample (e.g., diagnosed brain injury, severe visual or auditory problems, cerebral palsy, epilepsy or severe emotional disturbance). The sample was stratified on age; 18 Ss were selected from the age range 13-0 to 15-3 (mean 173.22), and 18 additional Ss from the range

9-5 to 11-8 (mean 127.28). The IQ range of the older EMR group was 56-79 (mean 71), the range of the younger group was 64-85 (mean 72.50). The MA range of the older group was 8-5 to 12-1 (mean 121.89); the range of the younger group was 6-3 to 9-0 (mean 92.17).

The socioeconomic status of the EMR Ss was determined by means of census tract data.

> Census tracts are small areas into which large cities and adjacent areas have been divided for statistical purposes. Tract boundaries were established cooperatively by a local committee and the Bureau of the Census, and were generally designed to be relatively uniform with respect to population characteristics, economic status, and living conditions. (U. S. Bureau of the Census, 1962, p. 1)

The 36 EMR Ss represented 11 census tracts in four planning areas which are described in Table 2. These planning areas were drawn up for the purpose of a proposal sent to the Office of Economic Opportunity by the Jackson Public Schools in 1965. Eleven EMR Ss came from area A, 11 Ss from area B, 10 from area C, and 4 from area D. The older EMR group included 6 Negro Ss and 12 Caucasian Ss. The younger EMR group included 5 Negro Ss and 13 Caucasian Ss.

CA normal group. The equal CA normal Ss came from the same five schools as the EMR Ss. A stratified random sample of Ss from regular classes was selected from boys of the same CA ranges as the two groups of EMRs and having non-verbal IQs from 100 to 125 on the Lorge-Thorndike Intelligence Test. Factors on which the sample was stratified included chronological age, planning area, and race. Eighteen Ss were selected from the CA range 13-0 to 15-3 and 18 additional Ss from the CA range 9-8 to 11-9. The older group had a mean age of 173.67 months, which did not differ significantly from the mean CA of the older EMR group ($p > .05$). The younger group had a mean age of 128.72 months which likewise did not differ significantly from the mean CA of the younger

TABLE 2

Socioeconomic Data on Groups as Stratified by Census Data

Area	Census Tract	Population*	% of Families with Incomes Less Than $3000	% of Area Non-White	EMR			CA Normal			MA Normal			TOTAL		
					O	Y	T**	O	Y	T	O	Y	T	O	Y	T
A	6,7,11	8,587	over 25%	68.16	5	6	11	5	6	11	5	6	11	15	18	33
B	2,10,12	13,795	15-24.9%	28.97	7	4	11	7	4	11	7	4	11	21	12	33
C	3,4,13	12,646	10-14.9%	34.70	5	5	10	5	5	10	5	5	10	15	15	30
D	8,9	9,435	less than 10%	0.16	1	3	4	1	3	4	1	3	4	3	9	12

*Total population Jackson, Michigan, 50,720 per 1960 census.

**O = older Ss; Y = younger Ss; T = Total

EMR group ($p > .05$). As in the EMR groups, 11 Ss came from planning area A, 11 from area B, 10 from area C, and 4 from area D. (See Table 2.) Also, as in the EMR groups, the older CA normal group included 6 Negro Ss and 12 Caucasian Ss; the younger subgroup included 5 Negro Ss and 13 Caucasian Ss.

MA normal group. The equal MA normal Ss also came from the same five schools as the EMR Ss. A stratified random sample of Ss from regular classes was selected from boys of the same MA ranges as the two groups of EMRs and having non-verbal IQs from 100 to 125 on the Lorge-Thorndike Intelligence Test. Factors on which the sample was stratified included mental age and planning area. Eighteen Ss were selected from the MA range 8-5 to 12-1 and 11 additional Ss from the MA range 6-3 to 9-0. The older equal MA normal group had a mean MA of 127.72 months which did not differ significantly from the mean MA of the adolescent EMR group ($p > .05$). The younger equal MA normal group had a mean MA of 97.67 months which did not differ significantly from the mean MA of the younger EMR group ($p > .05$).

As in the EMR groups, 11 Ss came from planning area A, 11 from area B, 10 from area C, and 4 from area D. (See Table 2.) The older MA normal group included 6 Negro Ss 12 Caucasian Ss; the younger group included 5 Negro Ss and 13 Caucasian Ss.

The MA match was made on the following basis. The EMR IQs were obtained from Stanford-Binet Intelligence Tests and the Wechsler Intelligence Scale for Children. The IQs on the normal boys were obtained on Lorge-Thorndike Intelligence Tests. Studies comparing these tests have found the Lorge-Thorndike IQ to have an overall correlation of .79 with the Binet IQ and a correlation of .77 with the WISC IQ (Knief & Stroud, 1959; Traxler, 1957, 1958). The correlation of the WISC and the Stanford

Binet Form L has been reported to be .82 (Krugman et al., 1951). As these tests were standardized on similar populations and correlate highly with one another, the IQs were treated as comparable.

The MAs were determined from the IQs using the formula:

$$MA = \frac{IQ \times CA}{100}$$

(Kirk & Johnson, 1951, p. 42). This formula is based on the Stanford-Binet concept of MA for children.

Characteristics of the six subgroups appear in Table 3.

TABLE 3

Descriptive Data on Subgroups (n=18)

		Older Subgroups			Younger Subgroups		
Group		CA*	IQ	MA*	CA	IQ	MA
EMR	$\bar{x}$	173.22	71.00	121.89	127.28	72.50	92.17
	s.d.	9.60	5.65	13.26	8.83	5.78	8.69
	range	156-183	56-79	101-145	113-140	64-85	75-108
CA Normal	$\bar{x}$	173.67	111.05	192.89	128.72	112.33	144.22
	s.d.	9.84	5.54	15.45	7.59	7.39	7.89
	range	156-183	101-125	168-218	116-141	99-123	125-157
MA Normal	$\bar{x}$	121.33	105.39	127.72	91.83	106.50	97.67
	s.d.	13.31	5.89	14.44	7.47	4.35	7.47
	range	101-141	97-122	102-145	75-106	100-115	82-111

*ages in months

Procedures

Generation of stimulus lists. The lists of stimulus nouns (see Appendix A) were generated by the investigator. The criteria for each list are as follows:

(1) A class concept encompasses all eight stimuli on each list.

(2) Each noun on each list represents an object familiar to children of mental ages from 5 to 15 years.

(3) Each item may be represented in object form, picture form, and word form.

(4) The words are within the reading ability of children reading at the second grade level.

The procedure in generating a list involved five main steps:

(1) Selecting a class concept.

(2) Listing items under this concept.

(3) Listing the defining attributes of each item.

(4) Comparing the number of defining attributes each pair of items has in common.

(5) Drawing up a hierarchy of items from two having nearly all defining attributes in common to eight having only one attribute in common. For example, in the class concept containers (List 2), jar and can are the first two items. They share attributes of being containers, holding liquids, storing food, being round, having lids, being found in the kitchen. However, the first item on List 2, jar, and the eighth item, envelope, share only the attribute of being containers, or holding something.

This procedure was adhered to as strictly as possible. However, it must be noted that the subjectivity of the procedure means that two individuals generating lists independently under the same class concept may not arrive at the same sequence of stimulus items.

Selection of stimulus items. For each noun on each list, an object stimulus, a picture stimulus, and a word stimulus were obtained.

The stimulus items on the object grouping task were actual objects rather than replicas, miniatures, or models. (Appendix A, Figures 14, 15, and 16.) The picture stimuli were black and white outline drawings on 5 x 8 cards. (Appendix A, Figures 17 through 29.) The word stimuli were printed in manuscript form on 3 x 5 white cards. (Appendix A.)

Pilot study. A pilot administration of the associative grouping tasks was undertaken for the following purposes:

(1) To determine the effectiveness of the administrative procedure.

(2) To determine if Ss of the age and IQ range suggested for the study would respond to the tasks given.

(3) To determine the appropriateness of the stimulus lists in terms of:

  (a) Familiarity of the Ss with the items

  (b) Length of lists

  (c) Discriminability of lists

  (d) Differences between lists.

(4) To determine the time required for administration.

(5) To standardize coding procedure and write a Scoring Manual.

(6) To determine the appropriateness of Hypotheses 1 through 5.

The pilot study is reported in Appendix B.

Training of examiners. Three examiners in addition to the investigator were trained in the administrative procedures. All examiners were Caucasian females with a mean age of 27 and at least two years of teaching experience. One three-hour group session was held in which a demonstration of the administration of the tasks was given, procedures explained, and administration manuals distributed. The examiners were given a week to practice administering the tasks to at least three normal children. They were then individually observed by the investigator in a test situation with a normal child to determine their competency.

Administration of tasks. Each of the 54 boys in the older subgroups was individually administered three associative grouping tasks: object grouping, picture grouping, and word grouping. Each of the 54 boys in the younger subgroups was individually administered two associative grouping tasks: object grouping and picture grouping. The younger subgroups did not receive the word grouping task because results from the pilot study revealed that younger EMR Ss could not be expected to read first or second grade level words. The presentation of the words was both visual and auditory. However, the younger EMRs who could not read the words would have a heavier memory load if the visual cues did not aid their grouping. Each task required a total of seven responses. Thus 21 responses were obtained from each S in the older subgroups and 14 responses from each S in the younger subgroups.

The order of presentation of tasks and the list used on each task were counterbalanced among the older subgroups so that effects of order and list would be distributed. Among the older Ss one third of each subgroup (EMR, CA normal, and MA normal) received the object grouping task first, the picture grouping task second, and the word grouping task last. Another third received the picture grouping task first, followed by the word grouping task and finally the object grouping task. The remaining third of the Ss received the word grouping task first, the object grouping task second, and the picture grouping task last. One third of the older Ss in each subgroup received List 1 as objects, List 2 as pictures, and List 3 as words. Another third received List 2 as objects, List 3 as pictures, and List 1 as words. The remaining third received List 3 as objects, List 1 as pictures, and List 2 as words.

In the younger subgroups order and list were systematically varied. A completely counterbalanced design was not possible due to unequal numbers of tasks and lists in the younger groups. One half of each younger subgroup received the object grouping task first, and the picture grouping task second; the other half received the picture grouping task first and the object grouping task second. One third of each younger subgroup received Lists 1 and 2 (communications and containers); another third received Lists 2 and 3 (containers and tools); and the remaining third received Lists 1 and 3 (communications and tools).

Each child was tested individually by one examiner. The administration of tasks was completed in one session which averaged about 20 minutes. Each administrative session was recorded by portable tape recorder. In addition, examiners wrote the S's responses on response sheets.

Each examiner transcribed his own recorded sessions so that an exact copy of the responses of the Ss and the questions of the examiner was obtained. The investigator made spot checks of the consistency of the transcription and the tapes.

A manual of specific directions for administration of the tasks appears in Appendix C. The examiners used this manual in the pilot, after which their suggestions were incorporated in the notes which appear at the end of the manual. The enlarged manual was used by the examiners in the major study.

Coding of responses. Responses of all Ss were coded independently by two judges as to strategy used in grouping. The scoring manual used appears in Appendix D. The coded strategies were compared and differences noted. The judges agreed on 87% of the coded strategies. In each case of disagreement, the judges discussed their differences and together made a decision as to the strategy involved.

Summary

The procedures described in the preceding chapter were designed to implement the testing of the hypotheses stated in Chapter III. Chapter V presents the results of the statistical analyses performed on the data collected by the above procedures.

V. Results

This chapter deals with the analysis of the data collected by the procedure described in Chapter IV. The discussion of the implications of the results obtained appears in Chapter VI.

The hypotheses were tested by looking at the effects of four sources of variance: (a) group - EMR, equal CA normal, equal MA normal; (b) age - adolescent, young; (c) number of stimuli in group - two to four, or six to eight; (d) stimulus materials - objects, pictures, words. The principal dependent variable was the number of superordinate strategies used on each grouping task. The adolescent subgroups were presented with 21 stimulus groupings (7 object stimuli, 7 picture stimuli, and 7 word stimuli). The young subgroups were presented with 14 stimulus groupings (7 object stimuli, and 7 picture stimuli).

Hypotheses 1, 2, and 4 involve the prediction of a directional difference between two means. A one tailed t-test was selected as the appropriate means of testing these hypotheses (Hays, 1963). Hypothesis 3 predicted an interaction between two variables - age and group, and therefore required a two-way analysis of variance (Winer, 1962). Hypothesis 5.A required a one-way analysis of variance to be followed by post hoc tests if a significant F is obtained. Hypotheses 5.B and 5.C required one tailed t-tests - again due to predictions of directional differences between means.

The following discussion refers to the analyses pertinent to each hypothesis, additional related data, and factors influencing the reliability of the data collected. All tests of significance were assessed using the .05 level of confidence.

Sources of Variance

Relative performance of retarded and normal children (groups). Hypotheses 1 and 2 refer to the effects of group as a source of variance. Table 4 presents the means and standard deviations for the number of superordinate strategies used on each task by each subgroup.

Hypothesis 1 compared the performance of EMR Ss to that of normal Ss matched on CA. In order to test the three aspects of this hypothesis, three t-tests were necessary.

The first t-test compared the older two subgroups on the mean of the total number of superordinate strategies used across three tasks: object grouping, picture grouping, and word grouping. Hypothesis 1.A is supported if adolescent EMR Ss use significantly fewer superordinate strategies than do equal CA Ss.

Figure 1 presents the data required for the comparisons in Hypothesis 1.A. Adolescent EMR Ss used a mean of 9.78 superordinate strategies across the three grouping tasks, while the equal CA normal Ss used a mean of 19.06 superordinate strategies. This difference was significant ($t=7.21$, df. = 34, $p < .01$) and supported Hypothesis 1.A.

The second t-test compared the younger two subgroups on the mean of the total number of superordinate strategies used across two tasks: object grouping and picture grouping. Hypothesis 1.B is supported if young EMR Ss use significantly fewer superordinate strategies than do equal CA Ss.

Figure 2 presents the data required for the comparisons in Hypothesis 1.B. Young EMR Ss used a mean of 3.50 superordinate strategies while the equal CA normal Ss used a mean of 9.11 superordinate strategies. This difference was significant ($t=4.96$, df. = 34, $p < .01$) and supported Hypothesis 1.B.

TABLE 4

Mean Number of Superordinate Strategies Used by Each Subgroup on Each Grouping Task (n=108)

Group	Age		Obj.	Pic.	Words	Total 1*	Total 2**
	Adolescent	Mean	3.33	3.39	3.06	6.72	9.78
	n=18	s.d.	2.16	2.25	2.33	3.59	5.03
EMR	Young	mean	1.72	1.77	--	3.50	--
	n=18	s.d.	2.19	2.01	--	3.18	--
	Total	mean	2.53	2.58	--	5.11	--
	n=36	s.d.	2.26	2.23	--	3.76	--
	Adolescent	mean	6.17	6.33	6.56	12.50	19.06
	n=18	s.d.	1.25	1.18	0.62	1.69	1.71
CAN normal	Young	mean	4.72	4.39	--	9.11	--
	n=18	s.d.	2.21	2.15	--	3.41	--
	Total	mean	5.44	5.36	--	10.81	--
	n=36	s.d.	1.92	1.97	--	3.17	--
	Adolescent match	mean	3.17	4.72	4.94	7.89	12.83
	n=18	s.d.	2.31	2.34	2.31	3.31	4.44
MAN normal	Young match	mean	3.56	4.67	--	8.22	--
	n=18	s.d.	2.36	2.22	--	3.63	--
	Total	mean	3.36	4.69	--	8.06	--
	n=36	s.d.	2.31	2.25	--	3.43	--

*Sum of objects and pictures

**Sum of objects and pictures and words

FIGURE 1

Mean Number of Superordinate Strategies Used by Older Groups Across Three Grouping Tasks (n=18)

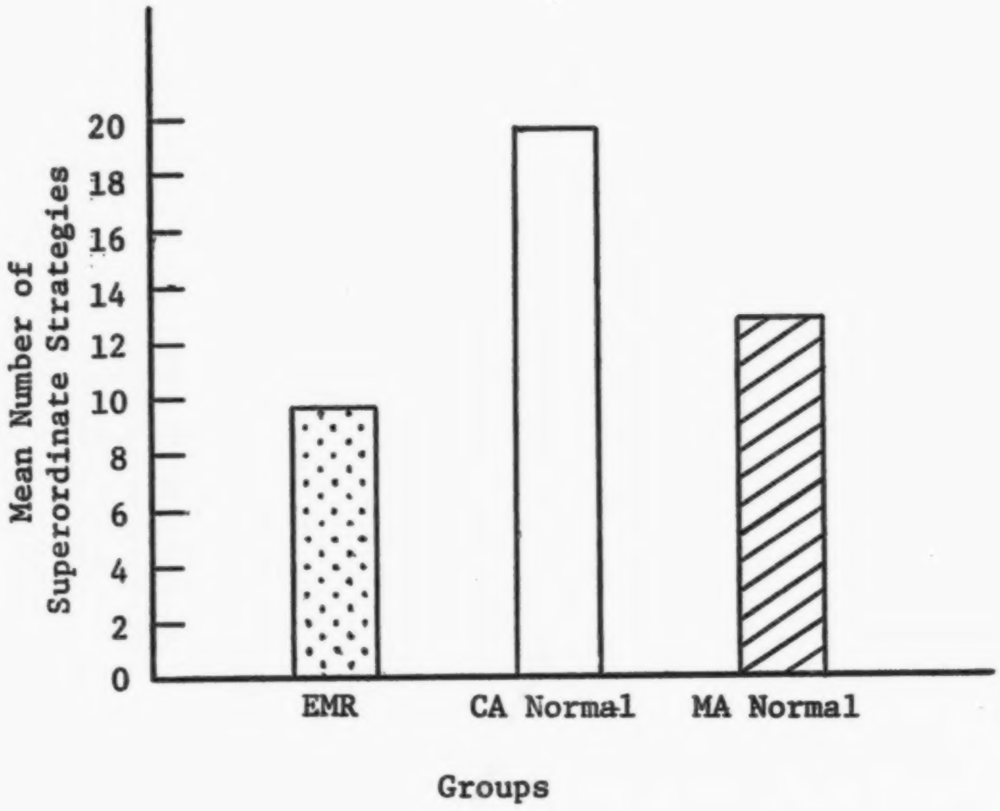
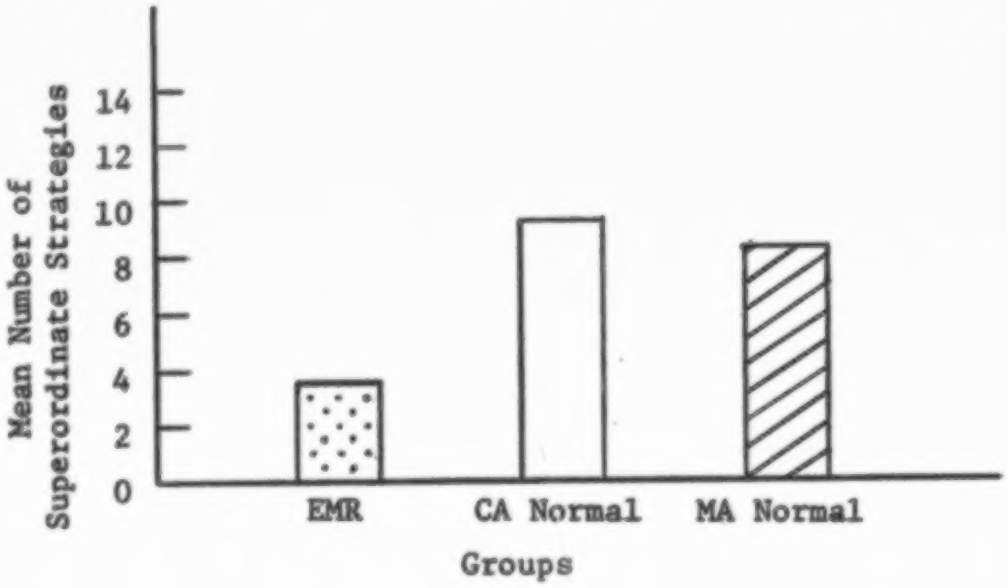


FIGURE 2

Mean Number of Superordinate Strategies Used by Younger Groups Across Two Grouping Tasks (n=18)

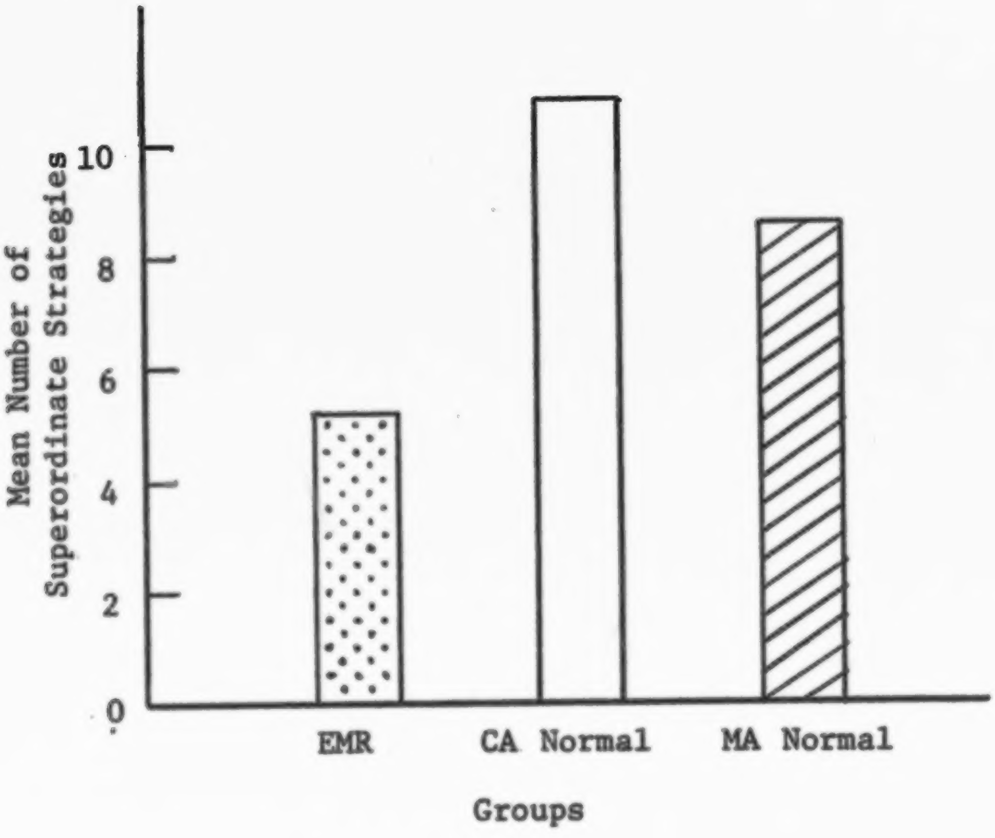


The third t-test compared the mean number of superordinate strategies of the combined adolescent and young subgroups across two grouping tasks: object and picture. Hypothesis 1.C is supported if the combined EMR age groups use significantly fewer superordinate strategies than do equal CA Ss.

Figure 3 presents the data required for the comparisons in Hypothesis 1.C. The combined EMR age groups used a mean of 10.81 superordinate strategies. This difference was significant (t=6.92, df = 34, p < .01) and supported Hypothesis 1.C.

FIGURE 3

Mean Number of Superordinate Strategies Used by Combined Age Subgroups in Each Group Across Two Grouping Tasks (n=36)



The data presented above support the hypothesis that EMR boys use significantly fewer superordinate strategies on associative grouping tasks than equal CA normal boys of the same socioeconomic status.

Hypothesis 2 compared the performance of EMR Ss with that of normal Ss matched on MA. In order to test the three aspects of this hypothesis, three t-tests were necessary.

The first t-test compared the older two subgroups on the mean of the total number of superordinate strategies used across three tasks: object grouping, picture grouping, and word grouping. Hypothesis 2.A is supported if adolescent EMR Ss use significantly fewer superordinate strategies than equal MA Ss.

Figure 1 presents the data required for the comparisons in Hypothesis 2.A. Adolescent EMR Ss used a mean of 9.78 superordinate strategies across the three grouping tasks while the equal MA normal Ss used a mean of 12.83 superordinate strategies. This difference was significant ($t=1.88$; $df = 34$, $p < .05$), thus supporting Hypothesis 2.A.

The second t-test compared the two young subgroups on the mean of the total number of superordinate strategies used across two tasks: object grouping and picture grouping. Hypothesis 2.B is supported if young EMR Ss use significantly fewer superordinate strategies than the equal MA Ss.

Figure 2 presents the data required for the comparisons in Hypothesis 2.B. Young EMR Ss used a mean of 3.50 superordinate strategies while the equal MA normal Ss used a mean of 8.22 superordinate strategies. This difference was significant ($t=4.04$, $df = 34$, $p < .01$) and supported Hypothesis 2.B.

The third t-test compared the mean number of superordinate strategies of the combined adolescent and young subgroups across two tasks: object grouping and picture grouping. Hypothesis 2.C would be supported if the combined EMR age groups used significantly fewer superordinate strategies than the equal MA Ss.

Figure 3 presents the data required for the comparisons in Hypothesis 2.C. The combined EMR age groups used a mean of 5.11 superordinate strategies while the combined equal MA normal groups used a mean of 8.06 superordinate strategies. This difference was significant (t=3.45, df = 34, $p < .01$) and supported Hypothesis 2.C.

The data presented above support the hypothesis that EMR boys use significantly fewer superordinate strategies on associative grouping tasks than equal MA normal boys of the same socioeconomic status.

Age effects. Hypothesis 3 refers to the interaction of age with two groups: EMR and equal CA normal. Table 4 contains the means and standard deviations pertinent to the following analysis.

The third hypothesis compared (a) the difference between the performance of adolescent EMR Ss and equal CA normal Ss to (b) the difference between the performance of young EMR Ss and equal CA normal Ss. To test this hypothesis, a two-way analysis of variance was carried out in which factor A was group (EMRs and equal CA normals) and factor B was age group (adolescent and young). The AB interaction represented a comparison of the difference in performance of the two adolescent groups to the difference in performance of the two young groups. This hypothesis is supported if a significant AB interaction reveals adolescent EMRs and equal CA normals are more divergent in performance than young EMRs and equal CA normals.

Table 5 presents the results of the two-way ANOVA. Factor A (groups) was found to contribute a significant amount to the total variance (F=60.16, $p < .01$) indicating that equal CA normal Ss used more superordinate strategies than EMR Ss on two grouping tasks. (See analysis under Hypothesis 1.C.)

TABLE 5

Summary of Analysis of Variance on Two Factors:

Group and Age (A=2, B=2, n=18)

Source of Variation	SS	df	MS	F
A (groups)	583.69	1	583.69	60.16**
B (age)	196.69	1	196.69	20.19**
AB	.11	1	.11	0.01
Within cell	660.39	68	9.71	

**Sig. .01 level

Factor B (age) was also found to contribute significantly to the total variance (F=20.19, $p < .01$) indicating that adolescent Ss used more superordinate strategies than young Ss.

The AB interaction was not found to be significant ($p > .05$) indicating that the effect of age on performance was not significantly different for EMR Ss than for normal Ss. Hence, Hypothesis 3 is not supported by the results of the present investigation.

Effects of number of stimuli. Hypothesis 4 compared the performance of EMR Ss on associative grouping tasks using small numbers of stimuli to performance on tasks using larger numbers of stimuli. In order to test the three aspects of this hypothesis, three t-tests were necessary.

Table 6 presents the means and standard deviations for the number of superordinate strategies used by adolescent and young EMR subgroups on groups of two to four stimuli (small) and groups of six to eight stimuli (large).

The first t-test analyzed the performance of adolescent Ss across object, picture, and word grouping tasks. Hypothesis 4.A is supported

TABLE 6

Mean Number of Superordinate Strategies Used by EMR Subgroups in Grouping Small and Large Numbers of Stimuli

		Small	Large	Difference
Adolescent	Mean	5.78	3.16	2.62*
(n=18)	s.d.	2.84	2.50	
Young	Mean	1.94	1.33	0.61
(n=18)	s.d.	1.70	1.41	
Total	Mean	3.00	1.67	1.33
(n=36)	s.d.	2.07	1.53	

*Sig..05 level

if Ss used significantly more superordinate strategies in responding to small groups of stimuli than they used in responding to large groups. Figure 4 presents graphically the data required for this comparison. Adolescent EMR Ss used a mean of 5.78 superordinate strategies on small groups of stimuli and a mean of 3.16 superordinate strategies on large groups. This difference was significant ($t=2.17$, $df = 34$, $p < .05$) and supported Hypothesis 4.A.

The second t-test analyzed the performance of young Ss across object and picture grouping tasks. Hypothesis 4.B is supported if Ss use significantly more superordinate strategies in responding to small groups of stimuli than they use in responding to large groups. Figure 5 presents graphically the data required for this comparison. Young EMR Ss used a mean of 1.94 superordinate strategies on small groups of stimuli and a mean of 1.33 superordinate strategies on large groups. This difference was not significant (p > .05) and Hypothesis 4.B is not supported.

FIGURE 4

Mean Number of Superordinate Strategies Used by Adolescent EMR Ss in Grouping Small and Large Numbers of Stimuli (n=18)

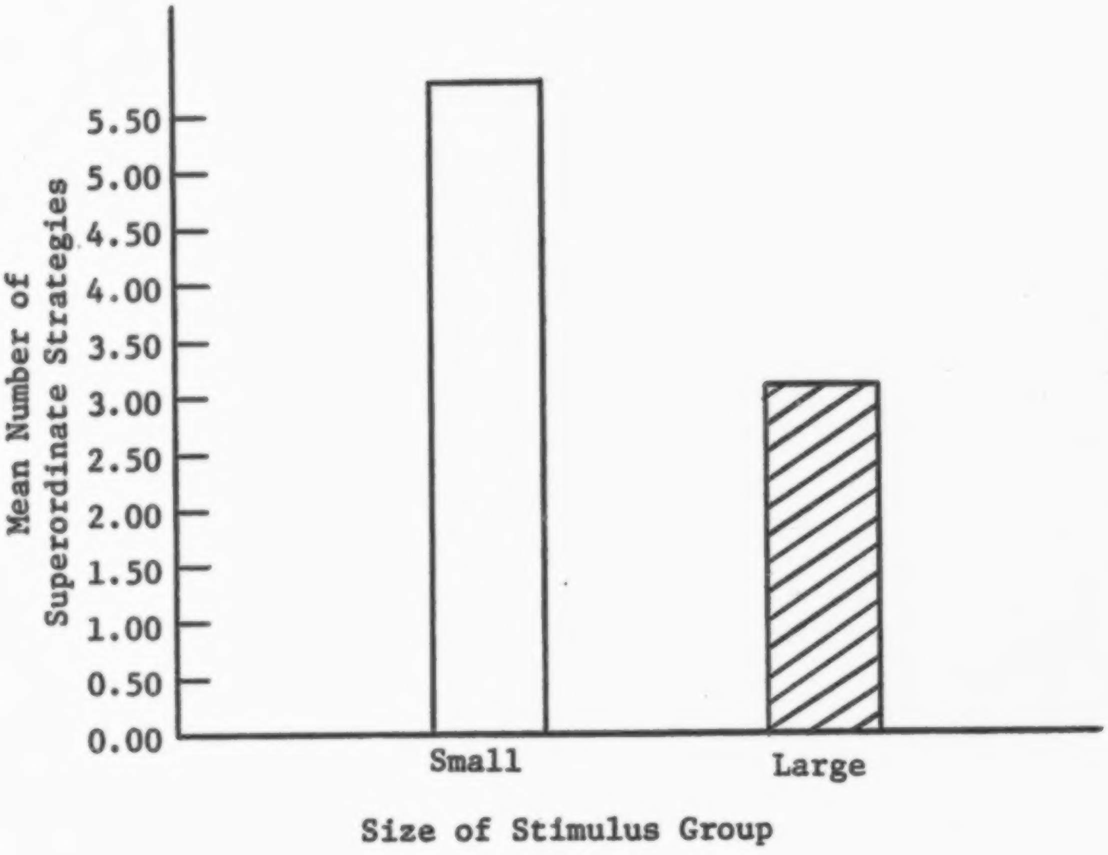
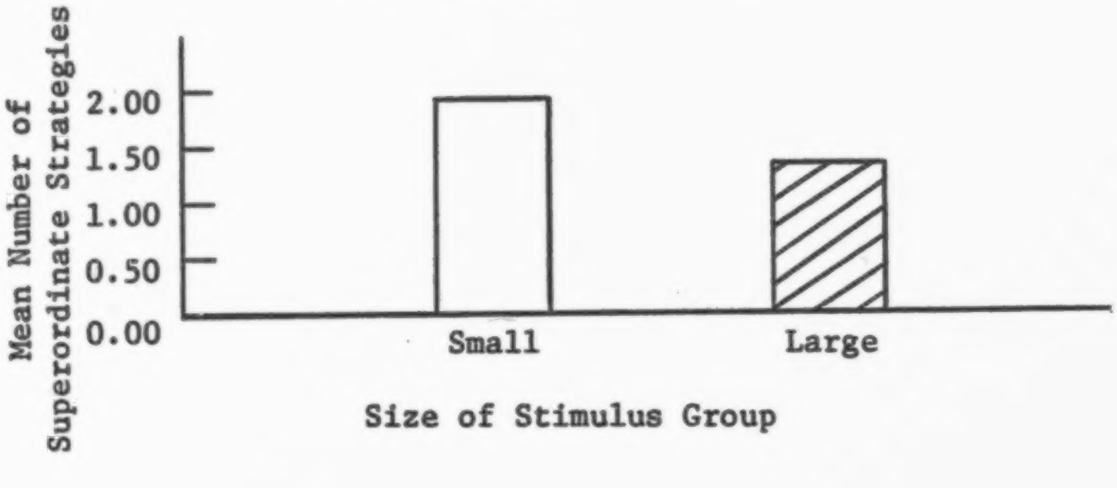


FIGURE 5

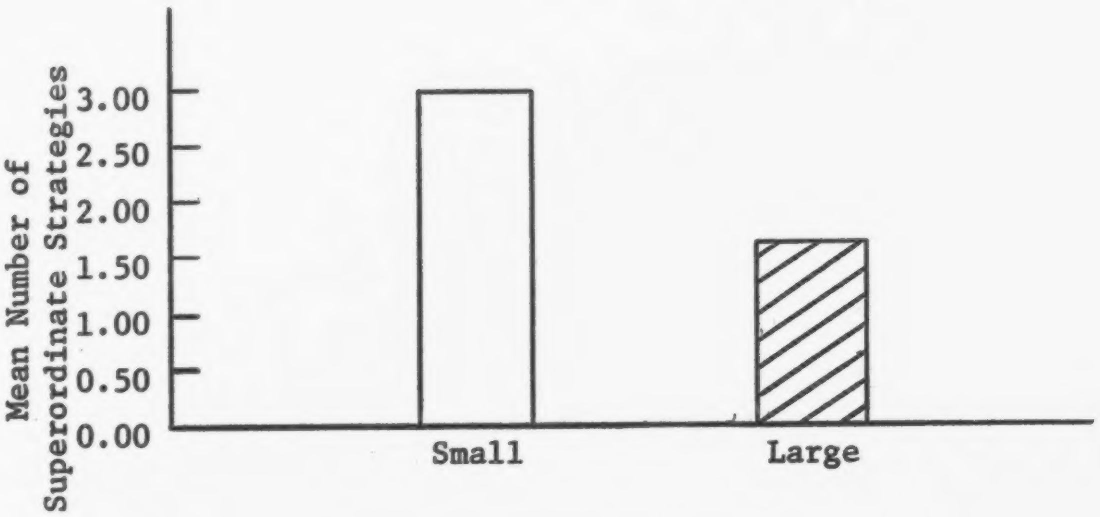
Mean Number of Superordinate Strategies Used by Young EMR Ss in Grouping Small and Large Numbers of Stimuli (n=18)



The third t-test analyzed the performance of all EMR Ss across object and picture grouping tasks. Hypothesis 4.C is supported if Ss use significantly more superordinate strategies in responding to small groups of stimuli than in responding to large groups. Figure 6 presents graphically the data required for this comparison. The combined age groups of EMR Ss used a mean of 3.00 superordinate strategies on small groups of stimuli and a mean of 1.67 superordinate strategies on large groups. This difference was not significant ($p > .05$) and Hypothesis 4 is not supported.

FIGURE 6

Mean Number of Superordinate Strategies Used by All EMR Ss in Grouping Small and Large Numbers of Stimuli (n=36)



Size of Stimulus Group

The data presented above demonstrated only partial support for the hypothesis that EMR boys use more superordinate strategies in grouping small numbers of stimuli than in grouping large numbers of stimuli.

Effects of stimulus materials. Hypothesis 5 compared the performance of EMR Ss on associative grouping tasks using different stimulus materials. Table 4 presents means and standard deviations necessary for the comparisons under Hypothesis 5.

In Hypothesis 5.A, the effect of three stimulus types (object, picture, word) on the performance of adolescent EMR Ss was analyzed. Support for this hypothesis requires a significant F-ratio on a one-way analysis of variance where the category is stimulus types.

Table 7 presents the results of the one-way ANOVA. The F-ratio obtained was not significant. Therefore the hypothesis that different stimulus types affect the performance of adolescent EMR boys on associative grouping tasks is not supported. The lack of support eliminated the need for posteriori tests on the three aspects of Hypothesis 5.A. Figure 7 presents the data graphically.

TABLE 7

Summary of Analysis of Variance on One Factor: Type of Stimulus Where Ss Were Adolescent EMR Boys (n=18)

Source of Variance	SS	df	MS	F
Category (Stimulus Types)	1.15	2	0.58	0.11
Within group	259.22	51	5.08	
Total	260.37	53		

Hypothesis 5.B compared the number of superordinate strategies used by young EMR boys on an associative grouping task using object stimuli to the number used grouping picture stimuli. The relevant data appear in Table 4, and graphically in Figure 8. Support for Hypothesis 5.B is demonstrated if young EMR Ss use significantly more superordinate strategies in grouping object stimuli than in grouping picture stimuli.

FIGURE 7

Mean Number of Superordinate Strategies Used by Adolescent EMR Ss on Object, Picture, and Word Grouping Tasks (n=18)

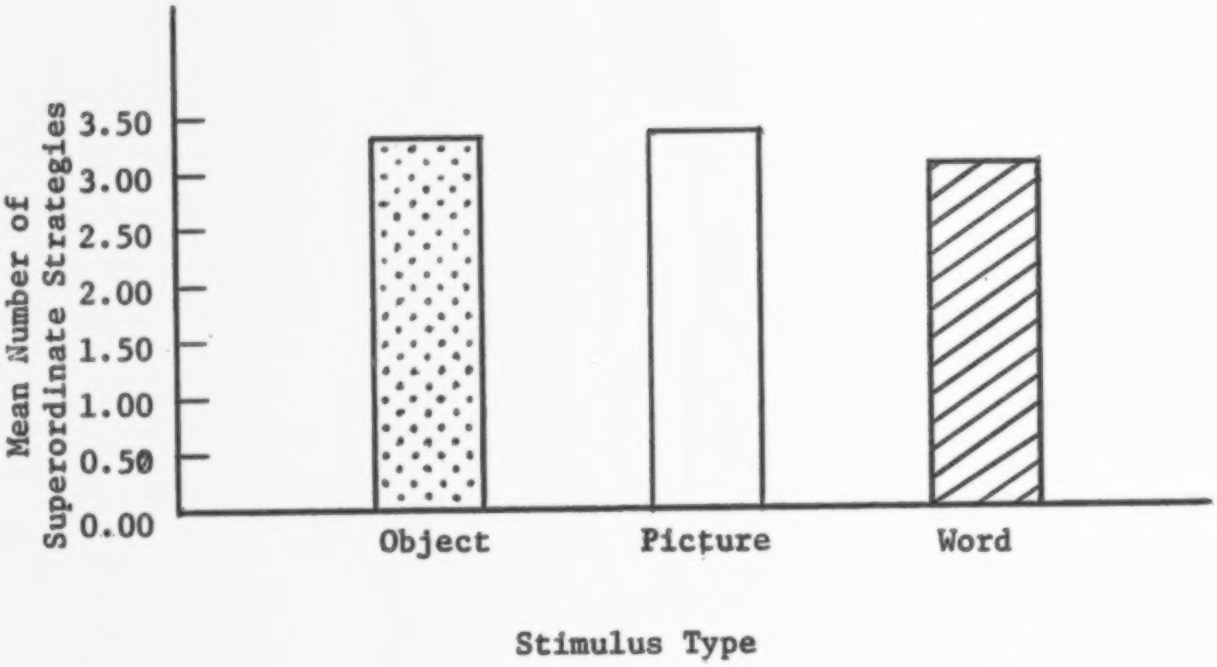
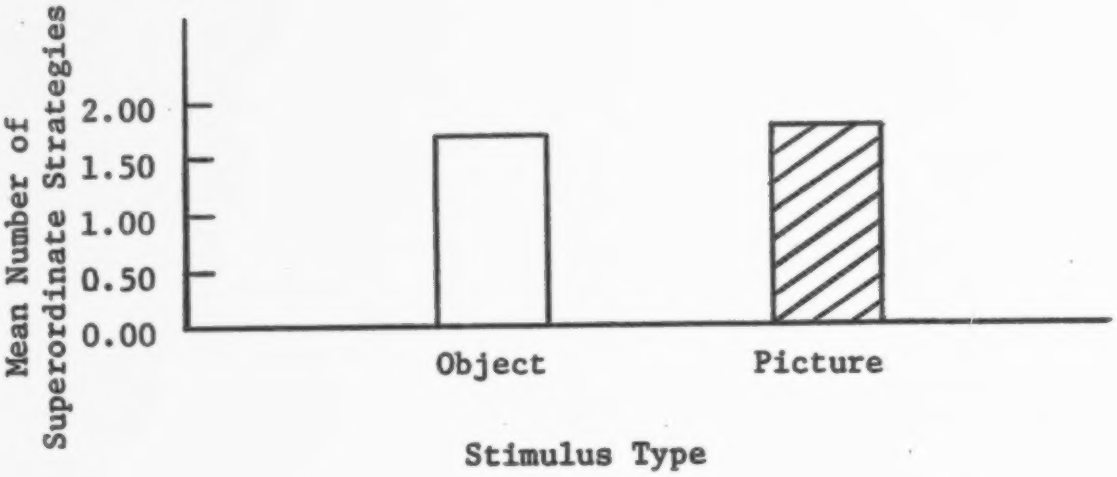


FIGURE 8

Mean Number of Superordinate Strategies Used by Young EMR Ss on Object and Picture Grouping Tasks (n=18)

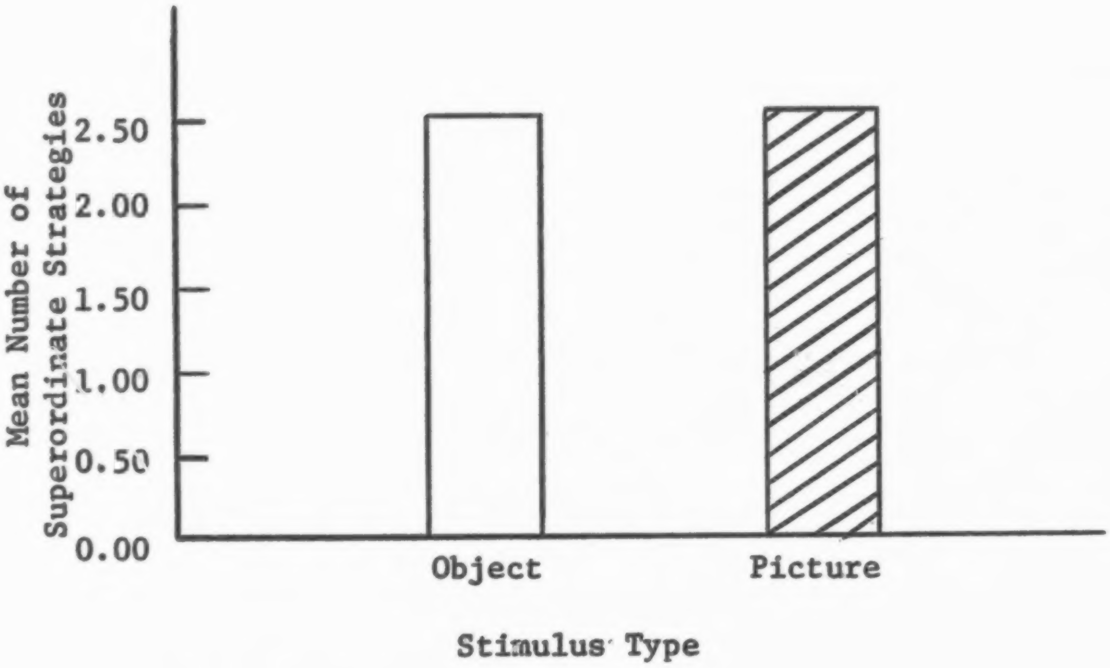


The results of the analysis revealed that young EMR Ss used a mean of 1.72 superordinate strategies in grouping object stimuli and a mean of 1.77 superordinate strategies in grouping picture stimuli. This difference was not significant. Hence, Hypothesis 5.B is not supported.

Hypothesis 5.C compared the mean number of superordinate strategies used by combined groups of adolescent and young retarded boys on an object grouping task to the mean number of superordinate strategies used on a picture grouping task. The relevant data appear in Table 4 and graphically in Figure 9. Support for Hypothesis 5.C is demonstrated if combined age groups of EMR Ss use significantly more superordinate strategies in grouping object stimuli than in grouping picture stimuli.

FIGURE 9

Mean Number of Superordinate Strategies Used by A Combined Group of Adolescent and Young EMR Ss on Object and Picture Grouping Tasks (n=36)



The results of the analysis revealed that EMR Ss used a mean of 2.53 superordinate strategies in grouping object stimuli and a mean of 2.58 superordinate strategies on a picture grouping task. This difference was not significant (p > .05), and Hypothesis 5.C is not supported. This finding might also be induced from the lack of significant differences on Hypotheses 5.A and 5.B.

The above results on Hypotheses 5.A, B, and C did not support the hypothesis that stimulus type affects the performance of EMR boys.

Analysis of Strategies

Although the dependent variable in this study was the number of superordinate strategies used on each grouping task, the judges classified each response given by each S as superordinate, complexive, or 'no grouping.' Table 8 presents the means and standard deviations of each type of strategy used by adolescent and young EMR, equal CA normal, and equal MA normal subgroups.

TABLE 8

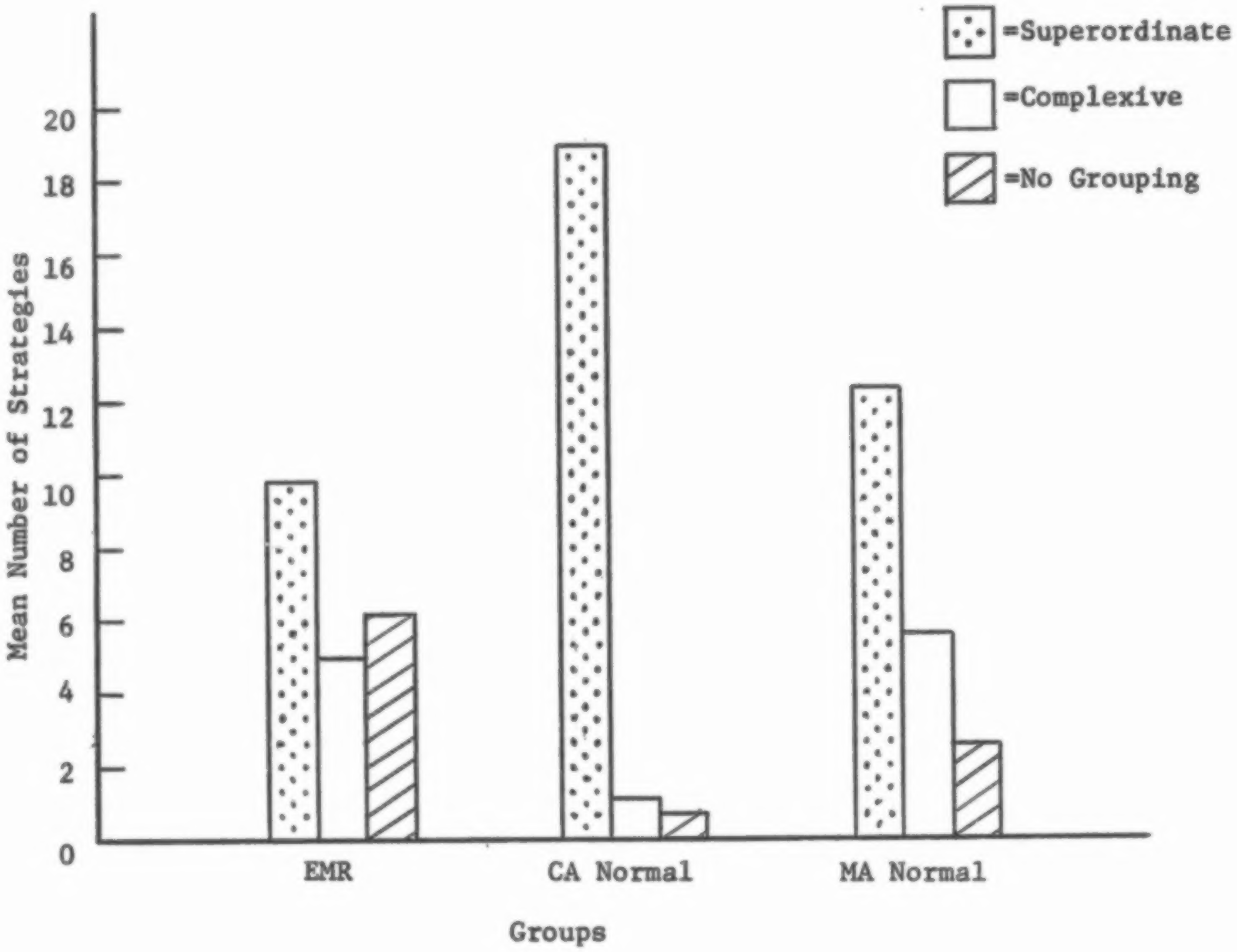
Mean Number of Strategies Used by Each Subgroup on Each Grouping Task (n=108)

Group	Age		Superordinate			Complexive			No Grouping		
			Obj.	Pic.	Word	Obj.	Pic.	Word	Obj.	Pic.	Word
EMR	Older	Mean	3.33	3.39	3.06	1.61	1.89	1.50	2.06	1.72	2.44
		s.d.	2.17	2.25	2.34	2.12	2.30	1.76	2.01	1.27	2.23
	Young	Mean	1.72	1.78	--	2.06	2.44	--	3.22	2.78	--
		s.d.	2.19	2.02	--	2.10	2.55	--	2.69	2.37	--
CA Normal	Older	Mean	6.17	6.33	6.56	0.50	0.56	0.56	0.33	0.11	0.33
		s.d.	1.25	1.19	0.62	0.99	1.04	1.04	0.59	0.32	0.49
	Young	Mean	4.72	4.39	--	1.22	1.39	--	1.06	1.22	--
		s.d.	2.22	2.15	--	1.44	1.82	--	1.21	1.40	--
MA Normal	Older	Mean	3.17	4.72	4.94	2.56	1.72	1.28	1.28	0.56	0.78
		s.d.	2.31	2.35	2.31	2.64	2.19	1.96	2.02	1.10	1.63
	Young	Mean	3.56	4.67	--	2.28	1.83	--	1.72	0.50	--
		s.d.	2.36	2.22	--	2.52	2.09	--	0.31	0.86	--

Figure 10 presents graphically the mean number of strategies used by the older groups summed across object, picture, and word grouping tasks. Figure 11 presents graphically the mean number of strategies used by young groups summed across object and picture grouping tasks.

FIGURE 10

Mean Number of Strategies Used by Older Groups Summed Across Object, Picture and Word Grouping Tasks (n=18)



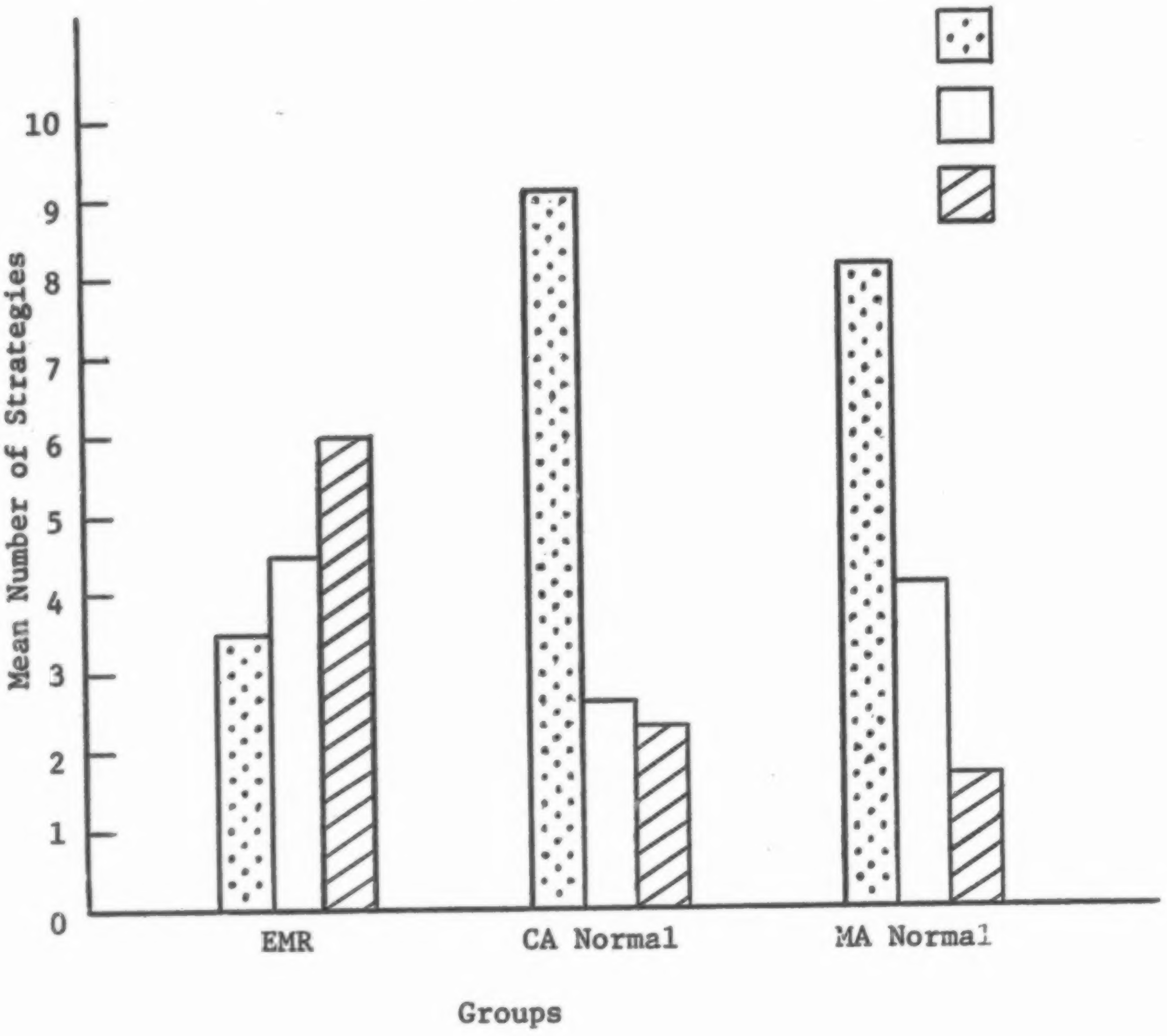
Factors Influencing Reliability of Data

The following discussion refers to factors not directly related to the hypotheses but which were analyzed for their effects on the dependent variable.

Effects of order and list. The pilot study demonstrated the insignificance of the effect of order of presentation of tasks, but the stimulus

FIGURE 11

Mean Number of Strategies Used by Young Groups Summed Across Object and Picture Grouping Tasks (n=18)



list used on each task was found to be a significant factor (Appendix A). Therefore the counterbalanced design was retained in the major study so that variance contributed by these factors would affect the three experimental groups similarly.

Adolescent and young Ss were analyzed separately as older Ss received three grouping tasks. Therefore each older S received all three stimulus lists and a completely counterbalanced design was possible. (See Chapter IV.)

The effects of order and list on older Ss were analyzed in a 3 x 3 x 3 x 3 analysis of variance with groups, order and tasks as between-subject sources of variance, and list as a within-subject source of variance. The design had repeated measures on list. A summary appears in Table 9.

TABLE 9

Summary of Analysis of Variance on Data for Older Groups for Four Factors: Group, Order, Task, and List (n=18)

Source of Variation	SS	df	MS	F
Between Ss	555.78	53		
A (groups)	268.26	2	134.13	34.93**
B (order)	4.93	2	2.46	.64
C (task sequence)	1.45	2	0.22	.06
AB	16.03	4	4.01	1.04
AC	29.40	4	7.35	1.91
BC	58.29	4	14.58	3.80*
ABC	73.75	8	9.42	2.45
Ss within groups	103.67	27	3.84	
Within Ss	340.00	108		
D (list)	100.71	2	50.36	27.08**
AD	19.81	4	4.95	2.66*
BD	19.14	4	4.78	2.57
CD	15.29	4	3.82	2.05
ABD	9.57	8	1.20	.64
ACD	29.19	8	3.65	1.96
BCD	11.97	8	1.50	.81
ABCD	33.99	16	2.12	1.14
D x Ss within groups	100.33	54	1.86	

*Sig..05 level

**Sig..01 level

The main effect of order among older Ss accounted for less than one percent of the total between-subject variance (F=.64) and was insignificant.

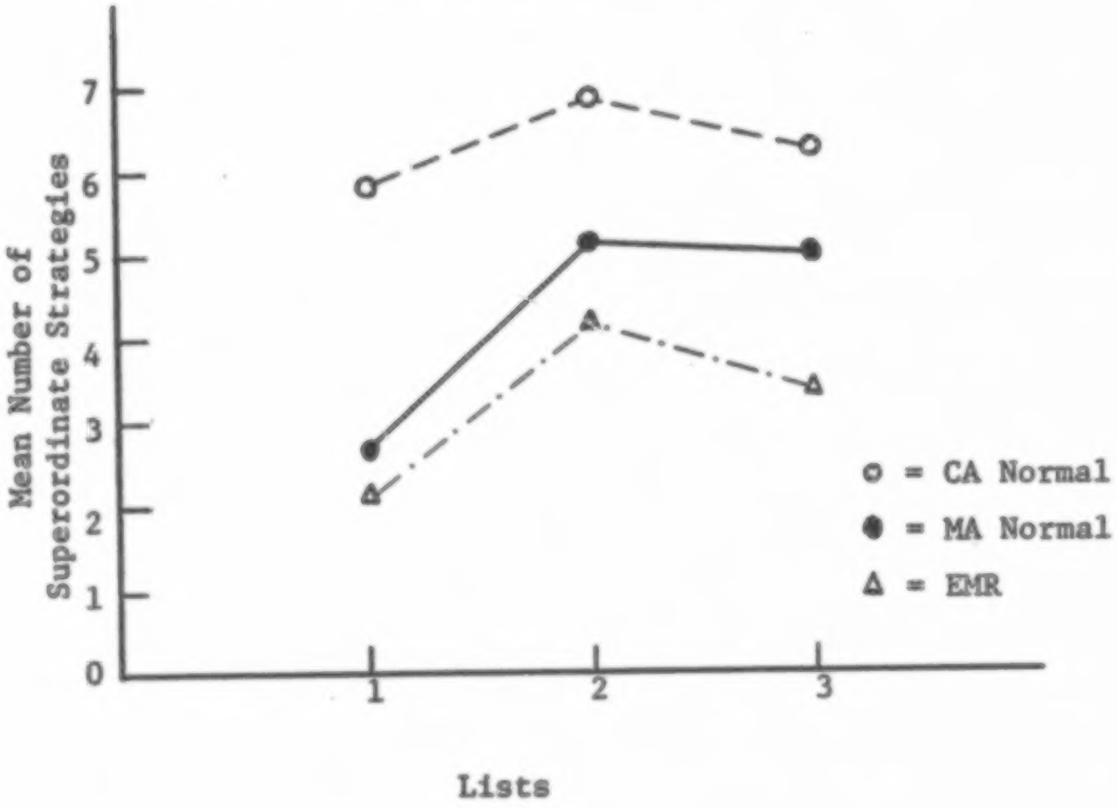
The interactions between order and the other factors accounted for little variance and were also insignificant.

The main effect of list accounted for a significant part of the within-subject variance (F=27.08, $p < .01$) in older S̲s. This duplicated the finding in the pilot study of a significant list effect. The group-list interaction accounted for 2.66 percent of the within-subject variance which was also significant ($p < .05$). Figure 12 presents the group-list interaction graphically.

FIGURE 12

Number of Superordinate Strategies Used

by Older Groups on Three Lists



Each group used fewest superordinate strategies on List 1 (Class concept: communications) and most superordinate strategies on List 2 (Class concept: containers) with List 3 (Class concept: tools) intermediate between Lists 1 and 2. However, the equal CA normal group demonstrated no significant differences between lists, while both EMR and equal MA normal groups used significantly more superordinate strategies on Lists 2 and 3 than on List 1. Table 10 presents the results of Tukey posteriori tests performed on each pair of lists for each group.

TABLE 10

Results of Tukey Comparisons of

Groups on Each Pair of Lists

	1 & 2	2 & 3	1-3
EMR	6.67**	2.46	4.20*
CA Normal	3.16	1.93	1.55
MA Normal	7.89**	.54	7.36**

*Sig..05 level

**Sig..01 level

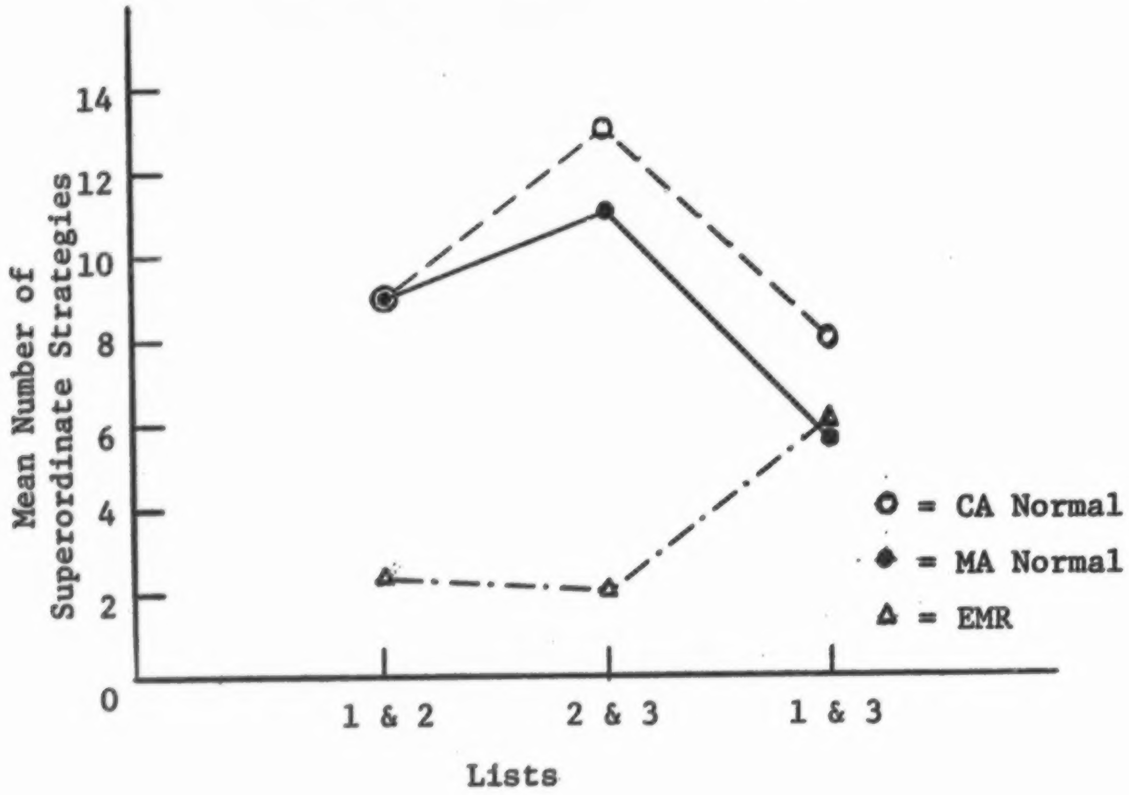
A completely counterbalanced design was not possible among young Ss as they received only two tasks and two of three possible lists. (See Chapter IV.) Half of each diagnostic group received the object-picture task sequence (n=9) and half received the picture-object sequence (n=9). One third of each diagnostic group received Lists 1 and 2 (n=6), one third received Lists 2 and 3 (n=6), and one third received Lists 1 and 3 (n=6).

Young Ss used a mean of 7.52 superordinate strategies on the object-picture task sequence and a mean of 6.37 superordinate strategies on the picture-object sequence. The difference was not significant ($p > .05$). Therefore a simple order effect was not found among the young Ss.

A mean of 6.78 superordinate strategies was used by young Ss on List combination 1 and 2, and a mean of 8.67 on List combination 2 and 3, and a mean of 6.56 on List combination 1 and 3. Differences among these means were not significant ($p > .05$). Figure 13 presents the number of superordinate strategies used by young groups on three list combinations. A group-list combination interaction is evident.

FIGURE 13

Number of Superordinate Strategies Used by Young Groups on Three List Combinations



Summary of Analysis

The hypotheses were tested by analyzing the effects of four variables acting on the dependent variable. Hypotheses 1 and 2 received unqualified support; Hypothesis 3 was not supported; Hypothesis 4 was supported only among adolescent subgroups; Hypothesis 5 was not supported. Table 11 presents a summary of the results of the tests of the hypotheses. Additional data not directly relevant to the hypotheses were presented.

Factors which might have influenced the reliability of the data were analyzed. No order differences were found but list contributed significantly to the variance. A list-group interaction also occurred.

TABLE 11

Summary of Results

Comparison	Hypothesis	Support
EMR < CA Normal	1A (adolescent)	$p < .01$
	1B (young)	$p < .01$
	1C (combined)	$p < .01$
EMR < MA Normal	2A (adolescent)	$p < .05$
	2B (young)	$p < .01$
	2C (combined)	$p < .01$
Age Effects (EMR < CA Normal)	3	None
Number of stimuli	4A (adolescent)	$p < .05$
(Small > large groups)	4B (young)	None
	4C (combined)	None
Stimulus materials	5A (adolescent)	None
(Object > picture > word)	5B (young)	None
	5C (combined)	None

The findings presented in Chapter V are discussed in Chapter VI.

VI. Discussion

Difficulties in forming and applying concepts have been attributed to the mentally retarded by both educators and psychologists (Blackman & Heintz, 1966; Rosenberg, 1963). However, research has been primarily *product* oriented as evidenced by the concern with comparing numbers of concepts or similarities between concepts in normal and retarded populations. The *process* of concept formation has been emphasized by Spitz (1966) who suggested that retarded children are deficient in their ability to organize incoming information.

The primary hypothesis guiding this work was the author's contention that EMR children habitually use less efficient strategies in reducing stimulus information than do normal children. Hence, the explanation for differences in number and quality of products is found in the cognitive processes of normal and retarded children. Bruner and Olver's (1965) approach to the study of associative grouping strategies was adopted by the author as a useful model for the investigation of the process of input organization in retarded and normal children.

The hypotheses in the present study were posited in light of research findings relating to input organization in the mentally retarded and they were framed in terms of the associative grouping strategies model. This chapter discusses the implications of the results reported in Chapter V.

Comparison of EMR and Normal Subjects

CA normal comparison. It was predicted that EMR *S*s would use significantly fewer superordinate strategies on associative grouping tasks than normal *S*s matched on CA. This hypothesis was supported by the data.

In the present study, Ss were presented with an array of stimuli and asked how the items in the array were alike. Ss had to impose an organizational structure on the stimulus items and respond to them in terms of their class membership rather than their uniqueness. The goal of this organization is reduction of the stimulus array through a categorization based on common attributes (similarity transformation). The evidence that EMRs use fewer efficient strategies of grouping has certain implications for his ability to profit from an array of stimuli--that is, to learn. The amount of information he can successfully process is limited. Therefore, in a learning situation, EMRs can be expected to perform below the level of equal CA normal Ss in amount of material learned. Studies by Stedman (1963) and Ring and Palermo (1961) corroborated this phenomenon as EMRs learned fewer word pairs than equal CA normals on paired associate tasks. Berkson and Cantor (1960) also found equal CA normals performed better than EMRs in a paired associate study which included the dimension of verbal mediation. However, a study by Eisman (1958) found no significant differences between EMRs and equal CA normals on a paired associate problem. She posited the simplicity of the task as an explanation for the lack of differences.

The grouping resulting from a superordinate strategy is different in form than a grouping resulting from a less efficient strategy (Bruner & Olver, 1965). Therefore the present finding that EMRs use fewer superordinate strategies than equal CA normal Ss implies that EMRs form different concepts when compared to normal Ss. This phenomenon has been observed in studies by Rossi (1963), Stedman (1963) and Wallace and Underwood (1964) in which differences in the clusters used by EMRs and equal CA normals were reported.

The difference in number and form of concepts or groupings formed by EMRs and equal CA normals suggests that they construct different conceptual frameworks. Hence, the meaning derived by an EMR from an experience is likely to be different from that derived by a normal child of the same CA.

Equal MA normal match. Comparison of EMRs and normal Ss matched on MA revealed that retarded Ss used significantly fewer superordinate strategies than equal MA normals. This finding supported Hypothesis 2.

The EMR Ss and equal MA Ss represented a similar level of mental development as measured by traditional psychometric techniques. Studies by Ring and Palermo (1961) and Cantor and Ryan (1962) have found no differences in the paired associate learning of EMR and equal MA normal Ss. Osborn (1960) found no differences on clustering performance in total words recalled. However, other studies have revealed a difference in the cognitive performance of EMRs and equal MA normal children. Rossi (1963) found differential performance on a clustering task. The present study, also, found a significant difference in their performance on grouping tasks. It is inferred that EMRs are not only slow in developing efficient strategies of grouping, as indicated by the EMR - equal CA normal comparison, but do not develop them even when younger normal children of the same MA do.

The qualitative deficit exhibited by EMRs on associative grouping tasks suggests hypotheses pertinent to the performance of EMRs on intelligence tests. Normal and EMR Ss having comparable MAs may be assumed to derive comparable meaning from test items. However, this study indicates that the process by which this meaning is derived differs qualitatively. Retarded Ss use fewer efficient strategies than do equal MA normal Ss. Therefore the form in which they process information differs. The EMR probably requires more cognitive effort to process the same amount of information.

The EMR has a chronological age advantage when compared to the younger equal MA normal child. Eisman (1958) suggested that the EMR is not as far behind the normal S on highly familiar materials as on unfamiliar. Following this line of reasoning, the EMR has had sufficient additional exposure to concepts in intelligence test items to compensate for his inefficient strategies. Thus, while the EMR and equal MA normal child have reached a comparable mental age, underlying processes differ.

Cumulative Deficit Hypothesis

The hypothesized differential effect of age on the performance of EMRs and equal CA normal Ss (Hypothesis 3) was not supported by the present study. However a ceiling effect was suggested in the performance of adolescent equal CA normal Ss. Adolescent normal Ss revealed means of 6.17, 6.33, and 6.56 superordinate strategies on the object, picture, and word tasks respectively. (There were seven possible responses on each task.) It is evident, then, that most normal adolescent Ss failed to use a superordinate strategy on less than one response in seven. The performance of the older equal CA normal group was possibly suppressed by the simplicity of the task. The test of Hypothesis 3 is viewed as inadequate in the present study because an insufficient range of difficulty of items was used in the experimental tasks.

Effects of number of stimuli in groups. The effect of the number of stimuli to be grouped was found to be significant among older EMR Ss, but not among younger EMR Ss or in the combined group. The within group variance sheds light on this finding. The young Ss varied more in performance than did the adolescent Ss. Although the effects of motivational factors were minimized by starting with a very simple task on which even the youngest child could succeed, many young EMRs were unable to perform on either the small or large groups of stimuli. The task then, was possibly too difficult for the young EMRs. The older EMR _Ss_ were able to respond with more efficient groupings to small numbers of stimuli than to larger groupings. This finding with older EMRs agrees with Bruner and Olver's (1965) finding among first, fourth, and sixth grade normal children that older children use more efficient groupings.

Effects of Nature of Stimulus Materials.

The nature of the stimulus materials was not found to be a significant variable in this study. There were no differences among adolescent EMRs on the object, picture, and word tasks, nor were differences found among young EMRs on the object and picture tasks. These findings did not support those of Van Osdol (1964) or Wallis (1963), who found EMRs performed better as tasks increase in degree of concreteness. Inasmuch as object, picture, and word grouping tasks represented a hierarchy of abstraction to the retarded _Ss_ in the present study, abstraction was not found to be a significant factor in the choice of strategy of associative grouping. The stimulus materials used in this study were similar to those used by Carr (1964) who also found no differences resulting from stimulus materials. The results of studies which found MRs to be more concrete are difficult to relate to the present study since they were primarily concerned with ability to utilize various sorting principles rather than the ability to utilize particular grouping strategies. The author concludes from the present data that there was no evidence which _confirmed_ the need of EMRs for more concrete materials in the classroom. However, this investigation was restricted to associative grouping tasks. It is possible that concrete stimuli may be of more importance in other tasks.

Analysis of Strategies

The data presented in Table 8 are of interest in light of the theoretical formulation of Bruner and Olver (1965). There were no predictions made regarding the complex formations and no groupings used by EMR and normal Ss. The differences between strategies were not analyzed statistically due to the contingency of the data. However, it does appear useful to discuss the trends suggested.

Looking first at the EMR groups, young EMRs used more no groupings than complexive or superordinate strategies (Figure 11). No groupings, according to criteria established, indicate no response, 'I don't know,' or an incomplete response. Even when the young EMRs did succeed in processing all of the items, it was more often in an inefficient manner (complex formations) than in an efficient manner (superordinate formations). In contrast, both equal CA normal and equal MA normal Ss used more efficient strategies to process the stimuli.

The equal CA normal groups demonstrated a developmental change comparable to that of Bruner and Olver's (1965) Ss. The use of superordinate strategies increased with age while the use of complexive strategies decreased.

Implications for Theory

Grouping strategies and arousal and attention theories.

Spitz (1966) has suggested a convenient framework for relating the grouping strategies model to arousal and attention theories. He contends that information processing includes the following distinguishable aspects: (a) S is alerted to the task situation (arousal), (b) S focuses on a specific stimulus or stimuli (attention), (c) S files some of the information into appropriate 'hold' area (input), (d) S holds input for permanent storage (temporary storage), (e) S retrieves material from temporary storage if necessary (recall), (f) S files into appropriate permanent file (storage), (g) S retrieves material from permanent file if necessary (recall). According to Spitz, information can be lost at any point in this process. The present study attempted to insure that information is not lost during steps (a) and (b). Ss are not asked to proceed past step (c), but merely to verbalize step (c).

It is evident that (a) arousal, and (b) attention must occur before input can take place. Other researchers have emphasized the first step (Semmel, 1966b) or the second (Zeaman & House, 1963) as areas of major deficiency among retarded Ss. The present work minimized the effects of these factors on performance as follows. The face to face interaction of examiner and S was assumed to keep the S in an aroused state. At any evidence of decay in the arousal level of the S, the examiner repeated instructions or otherwise encouraged him to respond. The nature of the task also aided in maintaining an aroused state. Following each response, a new stimulus was added to the stimulus array, the stimulus items were listed verbally by the examiner, and instructions were repeated, thus changing the stimulus environment. The addition of a new stimulus and repetition of instructions were also assumed to focus the attention of the S on the relevant task. However, the examiner did not attempt to influence the selection of attributes on which the S based his grouping. Each stimulus had a number of attributes on which the S could focus. Some of these attributes lent themselves more easily to forming associative groupings than other attributes. The stimulus items used in the study were familiar to Ss. The familiarity insured that the Ss all had some idea of attributes of the items through previous experience. However, the amount or kind of experience each S had was not controlled.

Grouping strategies and filter theory. Broadbent (1958) has conceptualized human perception as a single communication channel with a limited capacity. As the environment is constantly bombarding the learner with stimuli, he cannot process all the information with which he is presented. Broadbent has posited 'selective filters' which operate to separate relevant from irrelevant information. Hagen (1967) suggested that according to Broadbent's system, it is reasonable to assume that although the channel capacity of every organism is limited, for some the capacity is better utilized through the use of more efficient filters. The findings in the present work support Hagen's suggestion. The strategies used by EMR Ss are less efficient than those used by either equal CA normal Ss or equal MA normal Ss. Also, the strategies used by young Ss are less efficient than those used by older Ss.

Grouping strategies and Piaget's developmental approach. Piaget and his colleagues have been concerned mainly with the ways in which conceptual thinking develops. According to Piaget (1950; 1952) every intellectual act involves the incorporation of sensory data in the environment into existing response patterns (mental assimilation). It also involves the adjustment of existing response patterns to the sensory data existing at the time (mental accommodation). Adaptation is the state in which mental assimilation and mental accommodation are in equilibrium.

Piaget maintains that concept development occurs in distinct stages with profound changes occurring between 7 and 8 years and between 11 and 12 years. He contends that children before the age of 7 cannot think 'reversibly' and therefore are hindered in the formation of adequate concepts of classes, relationships, and numbers. During the sensori-motor stage the child is limited to the relations between objects that are perceptually present. This limitation persists in varying degrees through the concrete-operational stage (about 7 to 11 years) (Woodward, 1963).

Bruner (1965) contends that cognitive development is gradual rather than occurring in distinct stages. The development of more efficient grouping strategies parallels the development of operations observed by Piaget. An operation, according to Piaget refers to an act of intelligence which effects some conceptual organization or transformation of a particular set of objects of materials. In a sense, an operation may be thought of as an information processing device. For Piaget, as for Bruner, concepts of classes and relationships form the foundation of intellectual thought.

Children at the level of preoperational thought can sort objects or respond to a matching problem. However at this stage they rely on perceptual similarity and spatial proximity. They are not consistent and may shift the basis for grouping or fail to include all members of the stimulus array in the category. This stage was evident in the present study among the younger EMRs who often omitted items from the grouping resulting in a 'no grouping' score.

According to Piaget, the attributes of consistency and exhaustiveness are added to the sorting behavior of the child before the formation of concrete operations. The attribute of 'exhaustiveness' is necessary to Bruner's superordinate strategy. Wohlwill (1966) suggests that this change in sorting behavior results from the addition of verbal mediations which permit the child to organize his categories into an exhaustive set.

Piaget's theory of _groupings_ describes the way in which the child combines and reorders classes. This is beyond the scope of the present discussion, but the interested reader is directed to Wohlwill's (1966) paper on the Piagetian approach for further explanation.

Grouping strategies and the factor analytic approach. Theorists have attempted to study the human intellect by factor analyzing the trait scores from various psychometric measures into the separate factors which underlie them. The most well known model based on the factor analytic approach is Guilford's (1959) 'Structure of Intellect.' Guilford hypothesized that the human intellect is made up of 120 distinct abilities. Development of intelligence occurs in the direction of greater and greater differentiation of these abilities. There are three aspects encompassed by these abilities: operations, contents, and products. Guilford defines operations as things the organism does with the raw material of information (Guilford & Hoepfner, 1959). He distinguished five levels of operations: cognition, memory, divergent thinking, convergent thinking, and evaluation. It seems evident that cognition and memory are necessary to the other levels.

Strategies of associative grouping, when related to Guilford's model, represent a part of the first operational level, cognition. Cognition, according to Guilford (1959), involves the discovery, rediscovery, or recognition of information. It involves six levels of products arranged developmentally as follows: units, classes, relations, systems, transformations, and implications. Strategies of grouping fit into the second level: classes. Thus in Guilford's model, strategies of grouping develop at a relatively low level of differentiation.

Meyers and Dingman (1966) related Guilford's model to the study of mental retardation. They suggest that just as a child's intellect is less differentiated than an adult's, so can we expect the intellect of a retarded child to be less differentiated than that of a normal child. If less efficient strategies of grouping can be placed at a lower level of differentiation than superordinate strategies, then the present research supports Meyers and Dingman's hypothesis.

Implications for Language

The vehicle by which an individual expresses a concept or category is language. A number of theorists have emphasized the close connection between verbal learning and concept formation tasks (Lloyd, 1960; Metzger, 1958; Miller, 1956). Vygotsky (1962) feels the relationship between thought (concept formation) and language is a dynamic one. He posits word meaning as the unit of verbal thought, ~~and~~ that word meanings are constantly changing and developing as a function of experience. Vygotsky's three phases in concept formation describe the development of word meaning in a similar fashion to the way Bruner and Olver (1965) describe the development of strategies of associative grouping. To the young child who is in the first developmental stage of concept formation, word meaning denotes only a vague conglomeration of individual objects or events. During the second stage of development, thinking in complexes, word meanings denote bonds which actually exist between objects or events, but which are not critical bonds and therefore do not represent true concepts. During the third stage word meaning has evolved to approach a 'true' concept representative of an amalgalm of the child's experience. Hence, in Vygotsky's schema, the development of more efficient grouping strategies would produce more precise word meanings.

If the meaning given to a word depends on experience, then meaning changes as experience changes. Brown (1965) said that a word serves to label relevant experiences: to sum them over time into a concept which governs the use of the word.

While Vygotsky emphasizes the influence of thought on language, Milgram and Furth (1963) studied the influence of language on concept attainment in EMRs. They found that EMRs were comparable to normals matched on MA on concept tasks in which language experience was not assumed relevant,but inferior on language-relevant concept tasks.

O'Connor and Hermelin (1963) also have studied the relationship of language and thought in their work with trainable level children. They pointed out that naming, labeling, and verbal coding aid in singling out relevant features of a stimulus display. They found that verbal coding did not frequently occur spontaneously with retarded Ss. They took the position that MRs have a deficiency in acquisition and coding rather than in retention or transfer. The deficiency in coding consists in an ability to associate words and signs or words and percepts. This position supports Bruner's emphasis on categorization as a necessary form of coding.

Semmel (1966a) hypothesized that mentally retarded children tend to use sequential strategies in making similarity transformations and that this sequential predominance is the reason for their less adaptive language behavior. Studies by Semmel et al. (1966a; 1966b) have supported this position. The present study has found the EMR using fewer efficient strategies than normal children. The sequential nature of the strategies was not examined.

Many parallels to the development of strategies of associative grouping, as discussed by Bruner and Olver (1965), may be seen in McNeill's (1966) discussion of the acquisition of language. Language is hypothesized to be a universal hierarchy of categories in which each level is all inclusive and each lower level is a refinement of the one just above. The hierarchy is not single and immutable. There are numerous arrangements and a number of distinctions can provide possible starting points. McNeill posits a Language Acquisition Device (LAD) which receives as input the linguistic stimuli from the environment, and the output represents grammatical competence.

The internal structure of LAD is hypothesized to include the 'linguistic universals,' one of which is thought to be the hierarchy of categories; another is the basic grammatical relations. The function of the universal hierarchy of categories is to organize the data from the linguistic environment.

McNeill (1966) explains the child's acquisition of transformations in the same way that Bruner and Olver (1965) explain the acquisition of efficient strategies of grouping - in terms of cognitive economy. The child's memory is limited, as is the adult's. Efficiency demands the internalization of rules which lighten the memory load and eliminate 'cognitive clutter.' According to McNeill, 'By resorting to a word dictionary supplemented by syntactic and semantic rules, a child not only reduces the number of interpretations he will eventually have to remember, but also gains precision of expression by increasing the variety of his sentences and thus decreasing the overall ratio of interpretations per sentence.' In this view, the driving force behind language acquisition is the rapidly growing variety of semantic interpretations for which the child must find some means of differentiation and expression. Thus the EMRs inefficient strategies of grouping can be compared to inefficient use of language.

Lenneberg (1967) has argued that the capacity for language is specific and largely unrelated to other aspects of cognition. McNeill (1966) supported Lenneberg's position with evidence of basic similarities in the language acquisition of English and Japanese speaking children. He interpreted these similarities to reflect a biological basis for language which is unaffected by cultural factors. The present author suggests that McNeill's data might also reflect similar demands on the children for adaptation.

Whether thought influences language, as Vygotsky (1962) and O'Connor and Hermelin (1963) contend, or whether language influences thought, as McNeill indicates, has not been the concern of this investigation. Thought and language are inextricably entwined with one another. Rather than focusing on their separation, the focus in this work has been on how they operate together.

Implications for Education

The differences found between EMRs and equal MA normals have implications for behavioral modification. The admonition to wait and the EMR will catch up, does not have validity here. Therefore, if the EMR is to learn to use efficient grouping strategies, he must be trained in their use. There is some evidence that such a training program can succeed. Two studies (Penny & McCann, 1962; Rouse, 1965) have reported success in producing significant improvement in the performance of EMRs on productive thinking tasks. A study by Hohn (1967) reported a significant improvement in EMRs learning of paired associates when high level associative strategy aids were provided. The improvement brought their performance to the level of unaided normals. These studies indicate that the cognitive performance of EMRs can be improved through training.

VII. Summary

An information processing model was used to examine cognitive functioning of mentally retarded children. The human learner is viewed as being under constant bombardment by a multitude of stimuli. Since his capacity to process information is limited, he must reduce the informational content of the stimulus environment. This reduction takes place by means of various techniques of input organization.

Studies of cognitive performance suggested that retarded children are inadequate in the organization of input. Hence, an examination of input organization in normal and retarded children was undertaken. Bruner and Olver's (1965) model of associative grouping strategies was selected as a means to objectify the organizational process. Bruner and his colleagues found that the responses of normal children on a grouping task reflect three basic strategies: superordinate, complexive, and thematic. The superordinate strategy is the most efficient strategy of the three in terms of information reduction. As intelligence develops, strategies of grouping have been found to become more efficient.

The investigator hypothesized that EMR Ss use fewer efficient (superordinate) strategies on grouping tasks than do equal CA normal Ss or equal MA normal Ss. A cumulative deficit was hypothesized in the performance of EMRs as compared to the equal CA normals. The performance of EMRs was hypothesized to be adversely affected by increasing numbers of stimulus items in the grouping tasks. The stimulus materials were also expected to affect the performance of EMRs, with the most efficient strategies being used with object stimuli, the next most on pictures, and fewest on words.

The research design required the selection of three groups of Ss: a group of educable mentally retarded (EMR) boys, a group of normal boys matched with the EMRs on chronological age (CA normal group), and a group of normal boys matched with the EMRs on mental age (MA normal group). Each group was subdivided into two age groups. The older three subgroups received three grouping tasks: objects, pictures, and words. The younger three subgroups received two grouping tasks: objects and pictures. Groups were matched on socioeconomic status and race. The order of administration of the three tasks was counterbalanced with three stimulus lists so that effects due to order and list would not affect the dependent variable. The responses of the Ss were coded into grouping strategy categories by two judges.

As hypothesized, the results revealed that EMR Ss used fewer superordinate strategies than either equal CA normal Ss or equal MA normal Ss. Contrary to the cumulative deficit hypothesis, no differences were found in the effects of age on the performance of EMR and equal CA normal Ss. Partial support was found for the hypothesis that increasing numbers of stimuli decrease the use of efficient grouping strategies among EMRs. Finally, differential effects of stimulus materials were not evidenced in the results.

Differences found in the performance of normal and EMR Ss were related to findings of other studies of cognitive abilities in EMRs. Results relative to the cumulative deficit hypothesis were viewed as inconclusive since a ceiling effect was apparently operative among the older equal CA normal group. Effects of the number of stimuli in the group were found to be influenced by the difficulty of the task for the younger EMRs.

The grouping strategies model was related to various theories pertaining to cognitive performance and development. Implications of the findings for language and for education were discussed.

The grouping strategies model served as a useful tool for studying input organization in EMR children. The finding that EMRs use fewer efficient grouping strategies than equal CA or equal MA normal children provides insight into their poor performance on cognitive tasks. It seems reasonable to propose a training program for EMRs in the use of efficient grouping strategies. If successful, such a program could have far reaching effects on the cognitive performance of EMRs.

APPENDIX A

STIMULUS ITEMS

Objects
Page 76

Pictures
Pages 77 - 88

Words
Page 89

APPENDIX B

Pilot Study
Pages 90 - 98

APPENDIX C

Procedure for Administration
Pages 99 - 103

APPENDIX D

Scoring Manual - Associative Grouping Tasks
Pages 104 - 112

available from author upon request

Object Stimuli

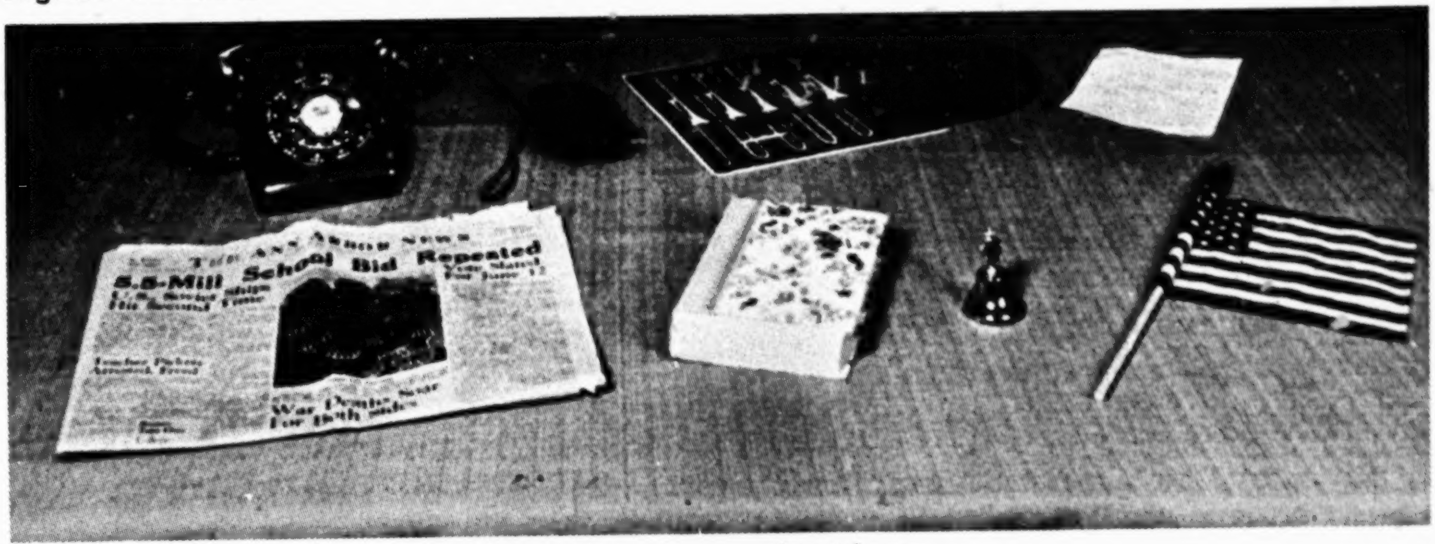

5.8-Mill School Bid Repeated

FIGURE 14 - Communications

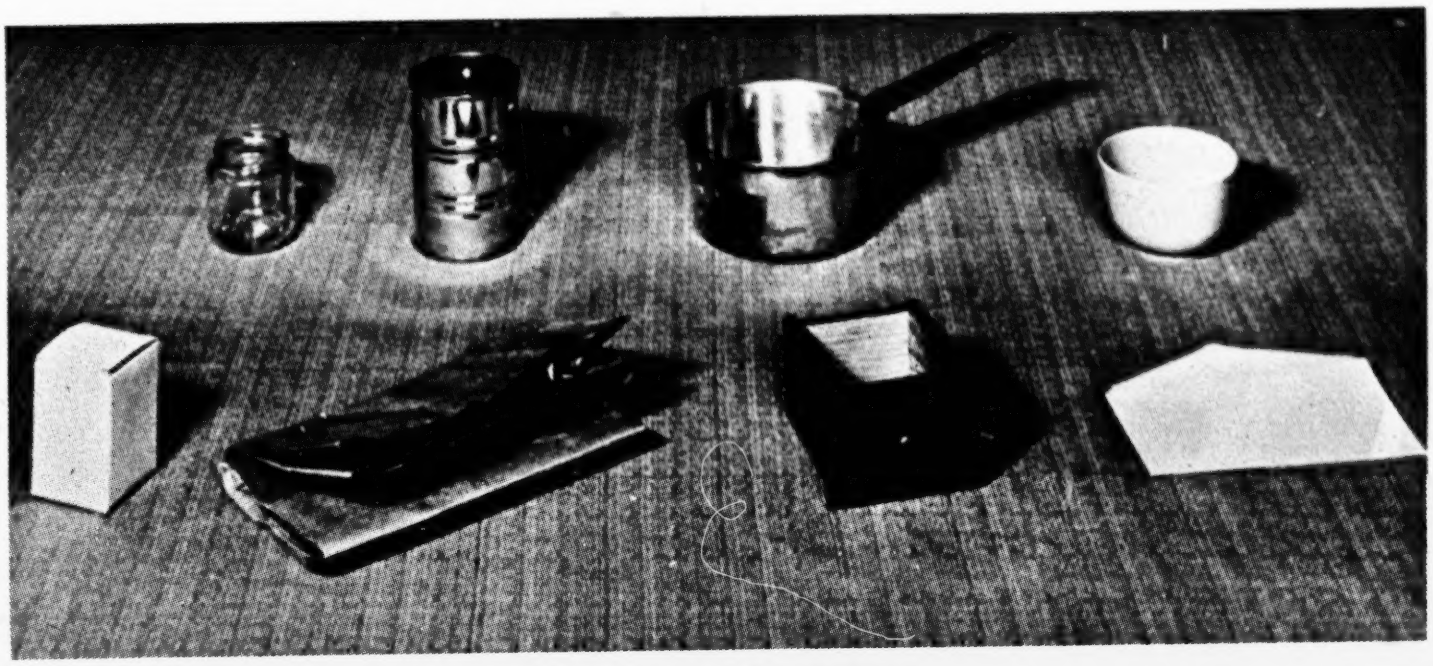


FIGURE 15 - Containers

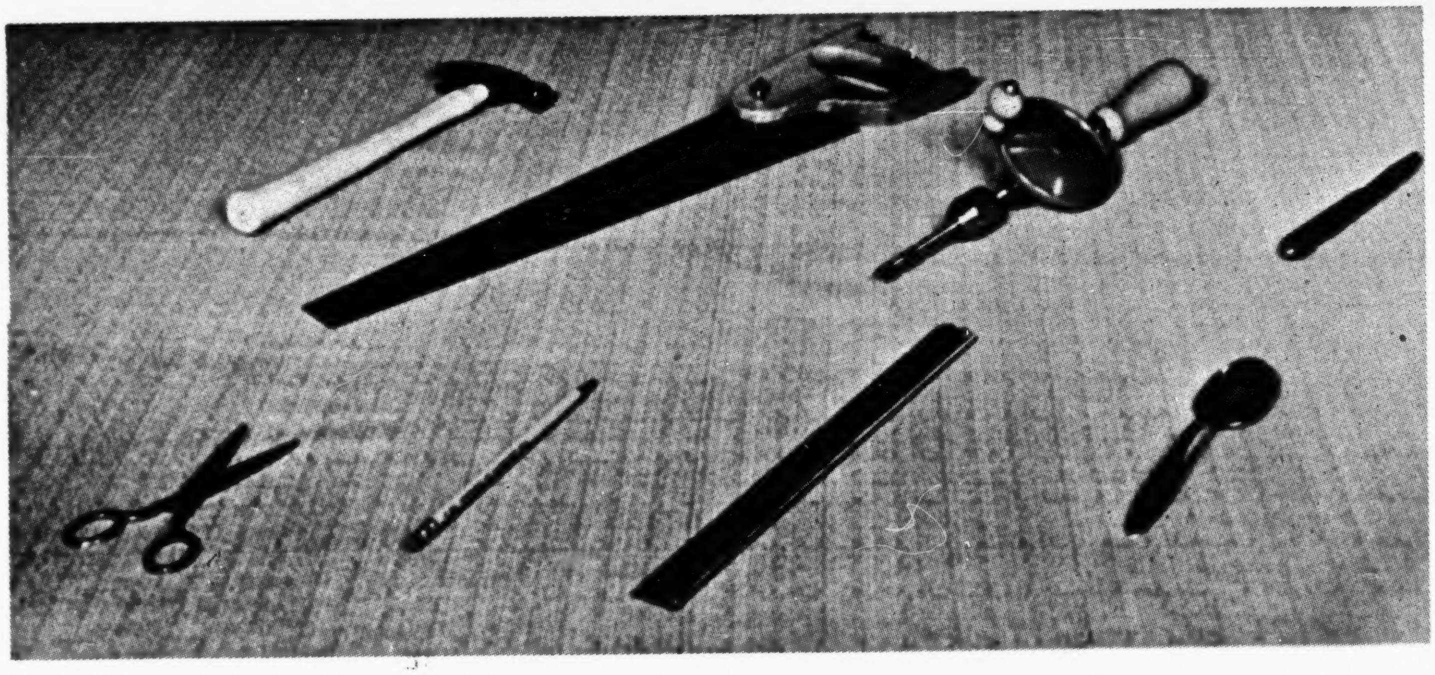


FIGURE 16 - Tools

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